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from your president's pen

The struggle for better health grows in intensity each year. Eagerly A.S.D.C. members give an increasing share of energy and ability that American children may have a happier life through their contributions to dental good health.

A.S.D.C. was organized to broaden the range of care given by the general practitioner, and to encourage development of new and more effective forms of care for children.

Educational programs and membership of both the national organization and state Units are being constantly expanded to meet increasing needs. The thought, money, professional skill and collaborative enterprise is a challenging and demanding activity. With each passing year, the capacity of the program becomes greater.

Such efforts, already stretched farther each year may seem extremely ambitious, but we look toward the long range goals of continuing direct service to children and fulfillment of unmet challenges.

WILLARD T. HUNNICUTT

A Digest of the Practice of Pedodontics

Part Three of Three Parts

SAMUEL D. HARRIS, D.D.S., F.A.C.D.

Editor's Note:

With this installment, we complete publication of Sam's text on pedodontics. We trust you have found the information presented to be practical and worth-while.

Please use the Comment page to send the author your questions or comments, to aid us in the next step—publication of the material in book form.

A. E. S.

CHAPTER XIII

Fractured Incisors

"Primary and Permanent"

WHEN a fracture occurs in a primary incisor and the pulp is exposed, it is generally best to extract the tooth. If the tooth appears favorable to treatment, pulpotomy should be employed. If the fracture does not produce an exposure, discing the tooth for comfort and appearance is all that is required.

A fracture in a permanent incisor is quite a different matter (Fig. 25). If the pulp is exposed or sufficiently close to the fracture surface to cause discomfort, it should be protected as soon after the accident as possible.

A pulp capping is employed and this covered with cement alone—or with cement and with silicate. I use a silicate crown form or an orthodontic band. The latter is mechanically more reliable. Should the pulp exposure be large, pulpotomy may be resorted to if the accident is recent and the pulp condition favorable; otherwise pulpectomy, complete pulp removal, is indicated. In pulpotomy (Fig. 25 D) a second layer of cement is placed for greater protection.

It happens quite frequently that the fracture is clean, and the child comes with the fractured portion of his tooth in his hand. In such cases, the broken part is inserted into an orthodontic band, then cemented back to the tooth along with the band. This has been done a number of times, and results in the appearance of a sound tooth carrying an orthodontic band. The procedure serves admirably until the child is ready for a permanent replacement.

Sometimes a permanent tooth is dislodged completely, yet the alveolus is not mutilated nor is the tooth fractured. In this case, a root canal filling is placed in the tooth aseptically. Then, following anesthesia and the proper incision of the gum tissues, a hole is drilled at the apex of the tooth socket. The air escapes through this hole when the tooth is inserted. The suction of the socket walls against the inserted tooth is such that the tooth will generally stay in position without assistance.*

* Maxmen, Harold, A. "An Aid in Successful Replantations of the Post Resection Canal Filling Technique," *Michigan State Journal*, Vol. 27 #6 (June 1945), pp. 118–123.

When some temporary support is wanted for the implanted tooth, it can be readily provided by attaching it to a firmly fixed neighbor, simply by building and cementing to place a band large enough to include both teeth.

When a permanent incisor is lost, a small acrylic splint supplying the lost member is built and is fastened with chrome alloy clasps to the bicuspids or to the permanent first molars.

Permanent replacement of the fracture portion of a vital incisor is not advisable until the child is at least fourteen—preferably sixteen—years of age. The restoration of choice is a porcelain or gold inlay, or a porcelain jacket placed as soon as this is mechanically feasible.

It is of interest to note that in the large majority of fracture cases, the affected teeth are predisposed to fracture by their improper occlusion. Thus, in the fracture of an upper incisor, the fractured tooth or teeth generally protrude well

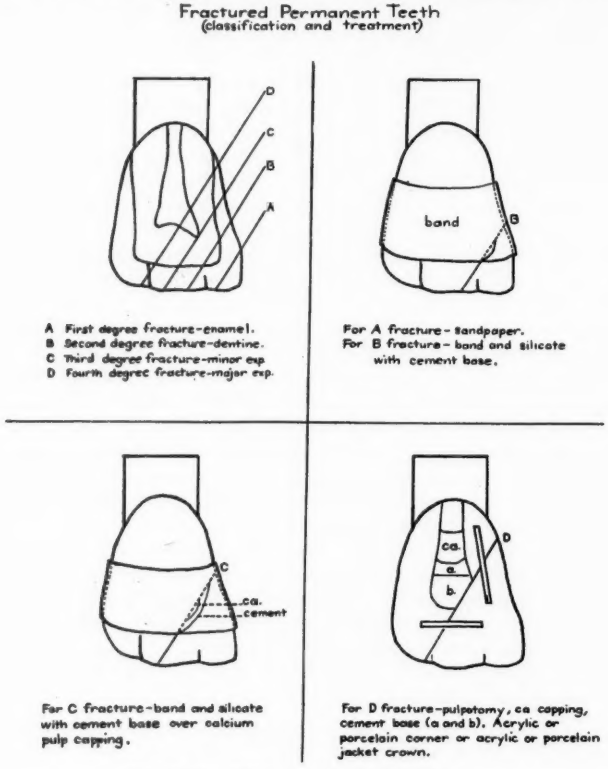


FIG. 25. Simplified management of fractures

beyond the lower incisors. In the fracture of a lower incisor, the lower tooth is likewise protruded or otherwise misplaced.

I have seen instances where properly positioned permanent incisors have been hit so hard that all four uppers were actually loose in the alveolus. Yet because they were well supported by the lower incisors, no fracture occurred. By contrast, I have seen fractures in cases predisposed to fracture by malocclusion where the blow was so mild as not to have registered on the child's consciousness. Very much as in chopping wood—when a stick is flat on the ground, a severe blow may not split it. When it is set at a proper angle for chopping, a slight blow will. This is a strong case for early orthodontics.

Good radiographs are indispensable in the treatment of fractured incisors—at the outset, to make sure that the root and process are unaffected; thereafter, periodically, to be certain that the root end condition remains favorable.

CHAPTER XIV

Space Maintainers and Pre-Orthodontics

"A Broad Field of Potential Service . . ."

SHOULD a space maintainer be used following the premature loss of a primary or a permanent tooth?

The use of space maintainers has been neglected consistently by some dentists, employed too frequently perhaps by others. The space maintainer is useful occasionally. More often it is not needed, will do no good, and may do harm.

A space maintainer should be used where otherwise the space will close beyond the width needed for the permanent successor.

When malocclusion is already present, the question of whether a maintainer should be used and how it should be constructed should be left to the orthodontist; or, if the family dentist is going to do the orthodontics, the space in question must be considered as it relates to the larger problem of straightening.

If the occlusion is satisfactory, then the dentist should measure the space and note this measurement on the child's record. At the next periodic visit—which might be in six months—he should measure the space again. If the space does not reduce beyond the width of the permanent successor, it may continue under observation. If the space begins to close and it appears as though this drifting is going to endanger the correct eruption of the permanent tooth, a simple space maintainer should be built.

The space maintainer need be no more complicated than the one illustrated (Figure 26). At one time I advocated functional space maintainers. These were difficult to construct, and experience has shown that they were quite unnecessary.

The simple space maintainer shown is built of a band—and a circular .025 wire contoured, annealed, and adapted to lie snug on the gingival tissue of the

Space Maintainers

A — One band with a one-loop maintaining space for the "d."

B — Two bands with a two-tooth loop maintaining space for the "e" and "d."

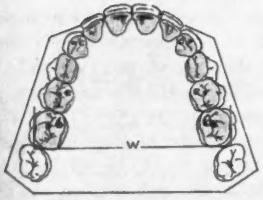
C — Spur attached to one-tooth loop maintaining space for the "e."

FIG. 26. Adequate space maintainers

Average Arch Width (children 2-11)

Age (years)	Maxillary				Mandibular			
	c – c	e – e	6 – 6	W	c – c	e – e	6 – 6	W
2	27.2	37.0	···	46.1	21.7	35.7	···	43.8
5	27.4	37.9	43.8	47.1	21.9	35.7	42.0	44.2
8	29.4	39.1	43.9	48.1	24.4	36.8	42.8	45.4
11	30.4	40.7	45.0	49.3	23.5	37.0	43.2	45.5

from Stanton and Goldstein



c c distance between cuspid tips.
e e distance between central pits of e's.
6 6 distance between central pits of 6's.
w buccal aspect of gum line of e's.

Cast of ideal occlusion at six superimposed on ideal occlusion at twelve. The markings refer to the above table on arch widths.

Ponts Index

A	B	C
If the combined mesio-distal diameter of the four upper incisors, is—	The distance between the central points of the first bicuspids is A + 25% of A or—	The distance between the central pits of the first molars is A + 36% of A or—
25	31	39
28	35	44
29	39	48.4
34	43	53

FIG. 27. Relative arch widths at different ages

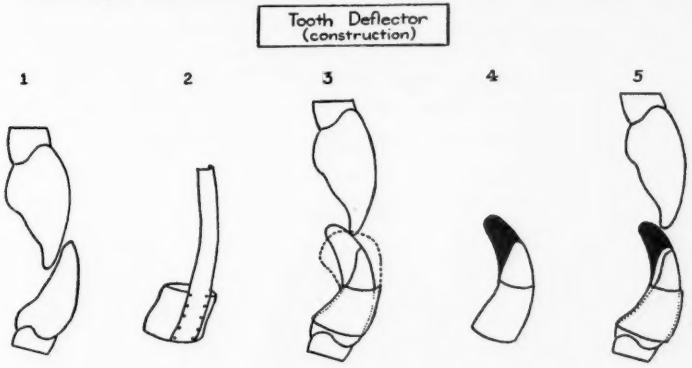
space to be maintained. Note that the mesio-distal diameter of the empty space, which is to provide space for a second bicuspid, should be the mesio-distal width of the second bicuspid—not that of the primary molar which has been lost. I have seen malocclusion actually caused by the use of space maintainers repeating the width of the second primary molar. The second primary molar is 20% wider than the bicuspid which replaces it; consequently the oversized space maintainer produced a disto-occlusion of the permanent molar.

Mouth habits are often difficult to control or to correct. In these cases, the correct time to institute orthodontic correction is a moot question even for the orthodontist. Thus, unless he is prepared to correct malocclusion, the family dentist will serve himself and his children best by referring this type of condition for observation to the orthodontist as early as possible.

Unless the family dentist expects to undertake the orthodontic correction, he should ask himself whether "observation" by him is hopeful but uninformed waiting. Correction may be delayed beyond the period when the orthodontist would prefer to begin (Fig. 27).

If orthodontics is going to be needed, and there is a question of treatment or of extraction of an abscessed or badly positioned permanent tooth, the family dentist will do his patient a great service if he will give the orthodontist the privilege of saying whether he would like the tooth saved. Such a tooth often means the difference between a short or a very long period of orthodontic correction. It may make the difference between an excellent or a mediocre result.

Some conditions of malocclusion can be corrected easily by the family dentist.



1. Lower incisor in labial version. 2. Band to which a vertical length of band material is welded or soldered. 3. This band is then placed on the tooth; the free end is then carried to the lingual, soldered to the band and returned to the tooth (dotted line). The folded side is contoured with the fingers (solid line) to permit it to slip under the upper central. 4. The incisal is reinforced with solder. 5. The deflector cemented on the tooth.

FIG. 28. Steps in the preparation of a deflector

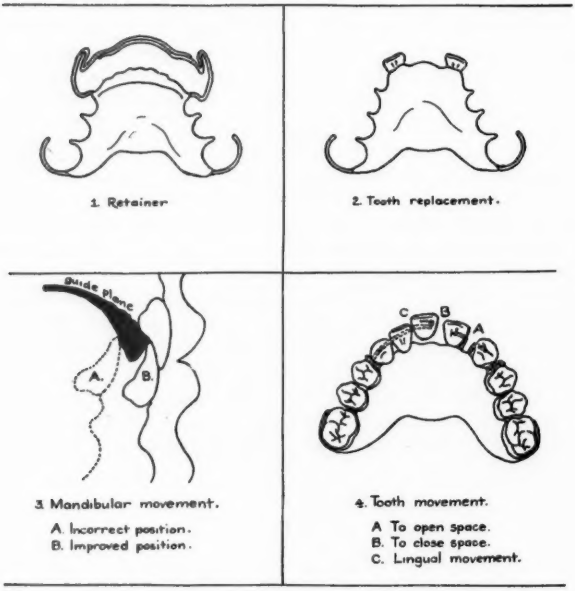
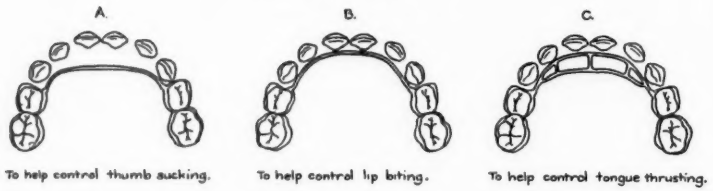


FIG. 29. Some of the manifold uses of the acrylic palate



A. A suction breaker.
B. A lingual with spurs.
C. A and B (without spurs) joined with cross bars.

FIG. 30. Simple appliances for helping to break mouth habits

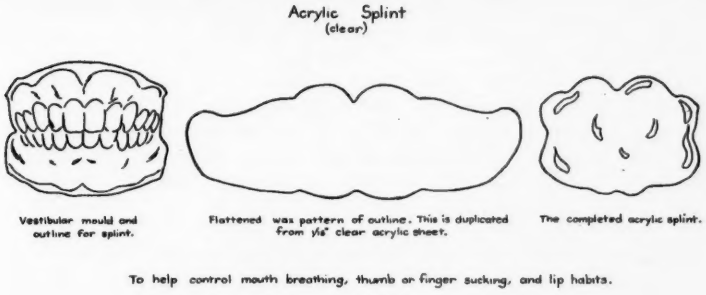

Acrylic Splint
(clear)
Vestibular mould and outline for splint.
Flattened wax pattern of outline. This is duplicated from 1/16" clear acrylic sheet.
The completed acrylic splint.
To help control mouth breathing, thumb or finger sucking, and lip habits.

FIG. 31. Construction of a shield for the oral vestibule

Where the occlusion is otherwise normal and an upper central is erupting or has erupted lingual to the lower incisors, the condition is easily corrected. A band with a guide ledge, as pictured (Figure 28), is cemented to the opposing lower incisor. This will generally swing the upper central over the lower in a matter of a few days.

Frequently acrylic bite-planes may be quickly and easily constructed to cover all the teeth opposite one or more malposed anteriors to bring these quickly into occlusion (Figure 29).

Much has been written about the correction of undesirable mouth habits. I have learned that parents are apt to have tried many things before reaching the dentist. A minor habit can become major if too much attention is given it. We advise parents not to punish, police, or bribe the child. Praise at times when a bad habit is overcome rather than constant fault-finding is the more effective approach. A simple applicance, (Figure 30) or an acrylic splint (Figure 31) may be of value.

Close cooperation between the family dentist and the orthodontist can be invaluable to the child. The family dentist will help much by referring the child to the orthodontist early; by taking radiographs and filling all the cavities therein shown, even to the slight fissures. The orthodontist, in turn, should insist that his patient return to the family dentist for prophylaxis and a checkup every six months or at the dentist's request.

CHAPTER XV

Periodontal Conditions

"Generally Acute With Quick Treatment Responses"

STOMATITIS, varying in type and degree from the common canker sore to a severely ulcerated Vincent's infection, comes under the observation of the dentist serving children. Stomatitis occurs commonly during an illness or

during the recovery period directly following an illness. The child's physical condition under these circumstances is below par. We ask the parent to consult with her physician, or we make recommendations to help build the child's resistance. This is important in the correction of stomatitis.

The most effective treatment of canker to date has been to neutralize it with a caustic. Ten per cent silver nitrate is touched to the canker proper, care being used not to involve any more tissue than is necessary. Talbot's Iodoglycerol, alum, and other mild astringents have been employed but have a limited value.

Vincent's infection in the child looks very much like it does in the adult. It is generally the acute type and lends itself readily to treatment. The child may run a temperature as high as 102–104°, and his oral tissues are often severely ulcerated.

The parent is advised to consult with the child's physician for proper diet and home care. In the event that no physician is available, she is advised to use plenty of orange juice—no spicy foods, no condiments—a simple diet and thorough elimination.

For home care, penicillin troches are prescribed, strength 5000 units. The troche is held in the mouth till dissolved—each two hours at first, less frequently as the condition improves. The condition seldom lasts more than seven to ten days.

Periodontal conditions due to loose teeth, infected teeth, and overhanging flaps are corrected by simply eliminating the cause. Should infection persist after the abscessed tooth or tooth fragment is extracted, one may be certain that not all the tooth has been removed. Sometimes, infection occurs because a food particle or some other foreign body is lodged between the teeth or below the gingival tissue. Once the irritating substance is removed, the gingival condition is relieved.

CHAPTER XVI

Anesthesia, Exodontia and Minor Surgery

"Significantly Simpler . . ."

THE ACTUAL extraction of primary teeth is relatively simple because they are not as firmly fixed as permanent teeth. Should a slight spicule or root remain following an extraction, it will generally be absorbed. The extraction of teeth for children, however, calls for a little special thinking and technique.

First, the anesthetic of choice for children under six is a general anesthetic with nitrous oxide or ethyl chloride preferred. For children over six, the anesthetic of choice may be novocaine or a general anesthetic depending upon the circumstances. It should be a rule that firmly fixed teeth should never be extracted for a child without the help of some anesthetic.

Ethyl chloride is an excellent general anesthetic for children where one to several primary teeth are to be removed within a matter of a minute or two. It

is applied on gauze held between the fingers as pictured (Figure 32). The Ethyl chloride is applied in spray form to the gauze from a distance of twelve inches. The nostrils are pinched closed, and the anesthetic is taken by mouth. I count slowly for the patient, whose right hand is raised; and, at the count of ten to fifteen, the hand generally drops. Extraction is undertaken at once. Anesthesia deepens for about twenty seconds after the spray is discontinued.

The anesthetic should not be repeated at the same sitting. Care should be taken that the patient swallows no blood. If these two precautions are observed, nausea which occasionally follows the use of a general anesthetic can be avoided.

Ethyl chloride is used for the large majority of primary tooth extractions at the Forsyth Infirmary for children where, perhaps, more teeth are removed for children than in any other institution in the world. It has been most satisfactory and well nigh fool-proof.

For the removal of permanent teeth, nitrous oxide or novocaine is the anesthetic of choice.

Infiltration anesthesia is generally employed for upper teeth and for lower cuspids and incisors. Conductive anesthesia is used for lower posteriors. The technique of insertion for infiltration is the same as that for adults except that

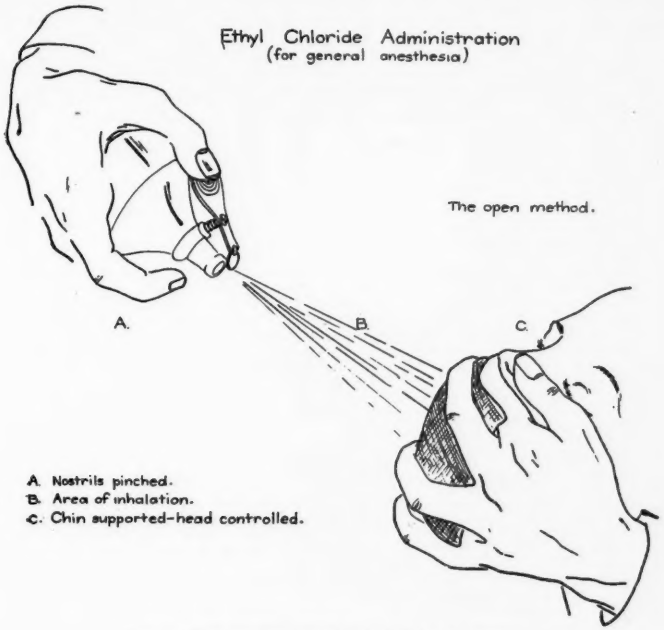


FIG. 32. The application of Ethyl Chloride general

the painful palatal injection is not needed. For mandibular conductives in children, the point of insertion is lower and more forward than for the adult because a lower, flatter mandible brings the mandibular foramen forward and closer to the line of occlusion (about $\frac{3}{8}$" above the occlusal planes and across the opposite cuspid). A smaller bore needle (23 gauge, $1\frac{1}{4}$ inch) and novocaine with a smaller percentage of adrenaline (2% novocaine, suprarenin content 1:50,000) is preferred for use with the child. If the suprarenin content is greater, the injection should be slower.

In figure 33 is illustrated the simplified technique evolved in my office for the mandibular injection. I use only one straight line movement, as shown, directed towards the mandibular foramen.

The injection is made slowly and gently, first inserting only the lumen of the needle and ejecting a few drops of the anesthetic. Then the needle point is advanced while the anesthetic is being injected. Note this is a single injection. *No buccal injection is made for lowers nor lingual for uppers.* Note also *that, frequently* BOTH *the right and the left side of* the maxilla or the mandible are anesthetized simultaneously, at the one appointment.

After considerable experimenting, I have found over the years that the buccal injection for lower teeth and the palatal injection for the upper teeth is not needed either for cavity preparation or for extractions. This is entirely true with primary teeth and generally true with permanent teeth for children.

I do not know if I am the first to anesthetize routinely both sides of the maxilla or the mandible. I have found it a considerable advantage. The child does not

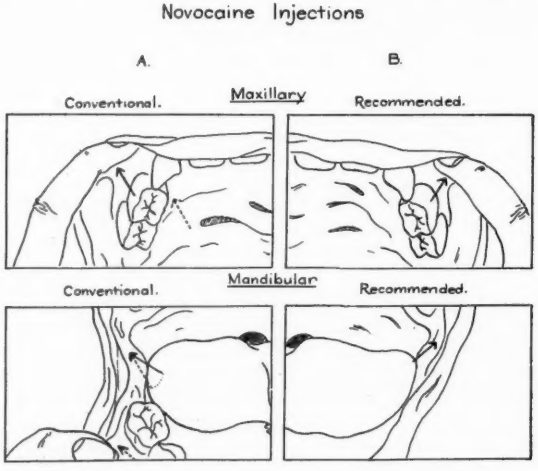


FIG. 33. The simplified technique of novocaine injection for children

experience the sharp contrast which occurs with numbness of only one side. It eliminates the strange sensation which causes the small child to chew the inside of his cheek—sometimes even a moment after being cautioned not to.

Further, anesthesia of the entire maxilla or mandible at one visit saves considerable operating time for the dentist. It takes only a few minutes for the anesthetic to take effect.

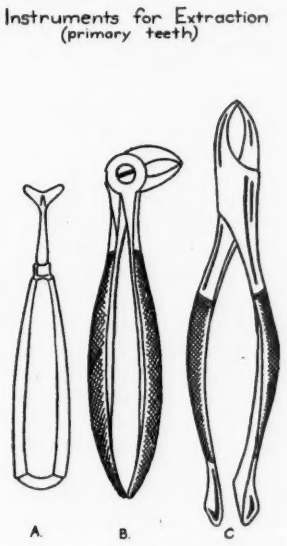

Instruments for Extraction
(primary teeth)
A.
B.
C.
A. A fishtail elevator (universal upper or lower).
B. An Ash lower # ep324 (universal for all lowers).
C. An SSW # 62 (universal for all uppers).

FIG. 34. The instruments advocated for extraction of primary teeth

For the removal of primary and permanent teeth, the instruments pictured (Figure 34) have been advantageous. The elevator is a special fishtail type, and is handy for scooping out the primary roots. It is more safe in use than most elevators because it has no point to engage, perhaps dislodging, the permanent bud.

If the bud of a permanent tooth is removed accidently, it should be replaced immediately and as carefully as possible. There is a good chance that it will become fixed and that it will develop into a useful tooth.

Employment of as few instruments with as little show as possible is particularly desirable in extractions for children.

CHAPTER XVII

Sodium Fluoride

THE VALUE of the topical application of sodium fluoride is widely accepted. I recommend it for my child patients.

I recommend its use with emphasis for those children who are most susceptible to caries. It is difficult, however, to draw a line between those children who do and those who *may* not need this treatment. Properly employed, it can do no harm. Research informs us that it can reduce caries by as much as forty percent.

The method advocated suggests the ideal ages as three, six, nine, and twelve. It calls for the application of the 2% sodium fluoride solution to each quadrant of the mouth which is previously dried and isolated with cotton rolls.

In actual practice, the initial time to begin is during or after the completion of all restorative dentistry. The first series might be administered to a child the age of three, or it might not be administered until the child is eleven or twelve.

It is not always possible to administer the service to the three-year-olds. Sitting patiently for a stretch of three continuous minutes is more difficult for some three-year-olds than actually submitting to pain. The physical taxation entailed by the time it takes to apply the sodium fluoride, and the repetition of this three subsequent visits is too much to expect from some three year olds.

Use a sand glass for timing to divert these small people. If this and your ingenuity are not sufficient to tide you over the treatment time peacefully, then I would wait for six months or a year to begin the first series of treatments.

For the treatment itself, I have developed several time-saving procedures.

First of all, with children in the nine to twelve age category, it is entirely practical to paint the lower right quadrant while isolating with cotton rolls the upper right which has already been painted and is drying. This makes it possible to do one half the mouth instead of one quadrant in three minutes.

With older patients, it is good to have them or the assistant hold the rolls in position rather than to consume valuable time holding them oneself. The assistant does this for the younger children.

CHAPTER XVIII

Diet and the Endocrines

"Underlying All Our Service . . ."

PROPER feeding obviates the need for much restorative dentistry. This is common knowledge.

Major alteration of the child's diet by the dentist is not always feasible, nor is it generally necessary. First of all, good cooperation for such major changes

cannot, as a rule, be obtained. Second, it is not essential for our immediate needs to change the diet beyond the replacement of sugar and white flour.

I usually discuss diet during the prophylaxis at the first visit in the following manner: "Mrs. Smith, does John eat much candy, chew gum, enjoy soft drinks, etc? Does he use sugar on his cereal? Does he prefer white bread? Sugar, white flour, and their products definitely help to produce cavities. Dried fruits and natural fruits and vegetables are a fine source of natural sugar. Replace his white flour with whole grain products. Whole grain products are much more desirable than white flour products."

The mother will make every effort to follow these simple suggestions. Where milk is being used a great deal to the exclusion of a more solid and fibrous diet, it may be suggested to the mother that she diminish the milk consumption in favor of the more solid foods. Washing meals down with water or milk is not desirable; however I know no reason why water or another drink may not be used at mealtime.

At least mention of the endocrines should be made here in passing. They have an important influence in our program of dental care. It seems entirely possible that the high incidence of incipient interproximal caries at twelve to fourteen is contributed to by endocrine changes or endocrine imbalance at the time.

True prevention in dentistry must come through proper diet. We can make a valuable contribution to the general health of our small patients by making timely suggestions in this respect. The best welfare of the child and of his oral cavity makes this advisable.

CHAPTER XIX

Some Observations

"Capsule Comments"

Black Stain: Frequently children's teeth are covered with a thin, hard black stain which either rings the tooth at the cervical or covers the entire tooth. It is one of the most unsightly stains; but, in my observation, the least detrimental.

This stain is found, strangely enough, in mouths that are relatively free of caries. In fact, this has been so typically the case that I have frequently hoped that time will permit my research into what it is that is linked with the stain or that is occurring concurrently which produces this possible immunity.

For practical purposes, the only concern that this stain need give us is its unfavorable appearance. It can be removed with pumice. If the parent is informed concerning its character, she will not be alarmed if some traces of the stain are permited to remain where it does not readily show, or if it returns soon.

I have speculated frequently on the cause for this stain. Perhaps it is due to an excess of iron or some other trace mineral in the diet. It is definitely unlike the green stain which appears on children's teeth and which so often is linked

with caries. Further, this black stain decreases as the child grows older, and most often disappears as he passes adolescence.

The Adrenals and Apprehension: Most of our problems with child management are produced or contributed to by the adrenals. The adrenals function to protect the individual in an emergency. The pouring of adrenalin into the system causes the child patient to become difficult—often despite his desire to cooperate.

Psychology may help but seldom does. Reasoning an adrenalin saturated child into a favorable mood for dental service often takes much time; and, just as often, such efforts meet with failure.

The adrenalin becomes dissipated in short order; therefore if no action probes the youngster into producing more, he soon becomes calm and easy to handle. For this reason, it is important that the child's first visit be a pleasant one.

Adrenalin is produced to help the child to escape from something that threatens or disturbs him. Physical action burns it up. For this reason, I prefer to let the child help me as much as possible. By holding the air line, keeping cotton rolls in place, or just holding himself in exactly the best position for administration of the necessary service, the child does two things.

First, the very action involved uses up the excess adrenalin in his system; second, his eagerness to help takes his mind off resistance and helps prevent the production of additional adrenalin.

Patterns of Behavior: The cooperative child is calm and obedient. The dentist experiences no difficulty in positioning him in the chair. This child will keep his feet firmly on the footrest, his hands resting easily on the arms of the chair, and he will hold his head in the most desirable position in the headrest.

The child who is frightened or recalcitrant presents a very different picture. He holds his body away from the operator, twists his feet, clasps his hands, and turns his head away. As a first measure of defense, he is very apt to close his eyes and to close his mouth partially—or hold it at an angle—which makes administration of dental service difficult.

It is important, in the case of the troublesome child, to prevent further development of the unfavorable pattern and to induce the child to assume a favorable one. Upon the measure of our success in accomplishing this end will depend the degree of cooperation we will receive from the child. It is a psychologically accepted fact that a calm exterior produces a calm interior—a perturbed attitude makes for a difficult patient.

It is further important to recognize that the unfavorable pattern follows a definite sequence in manifesting itself. First, the child moves his hands and feet out of position, twists his body, closes his eyes, and remonstrates, first feebly then with increased vigor. The earlier the pattern is corrected the easier it is to prevent the child from becoming an extreme management problem.

Understanding and observation go a long way towards preventing children from becoming problem children in the dental office. It pays to keep the child "in line" through kindness, but definite firmness is sometimes essential. It is seldom necessary to strain a child's cooperation no matter how difficult the service is that needs to be rendered. If a failure occurs, I look to find what I have done

wrong; for I am convinced that there is a way to handle every normal child successfully.

Gagging: Gagging is a normal reflex engendered on occasion when a person desires to dislodge something from his oral cavity.

Children are apt to gag as a defense mechanism—frequently when no good physical reason is evident. Most often this has been encouraged by the parents who, unconsciously and often with an air of alarm, have trained the child from babyhood to "spit" things out. If the child gagged or even regurgitated in the process, it may have induced sympathy or engendered excitement—this the child may have enjoyed.

Occasionally a parent, not understanding the effect of her words, will introduce her child to me with, "Doctor, be careful, he gags," or "he is apt to throw up." Thus armed, the child performs to suit the "build-up."

Two methods of handling the gagging child have proved effective.

The first is preventive. When this type of child senses saliva in his mouth, he wants to expectorate; and, not being permitted to at the moment, he gags. I have him *swallow*—not expectorate. When he has done this several times by request, he then begins to do it automatically; consequently the immediate cause for gagging is removed. It is also essential for me to build this child up favorably by introducing my fingers and necessary instruments into his mouth gradually and with due consideration.

The next method of handling this gagging, particularly when it becomes evident that it is willful, is through decided firmness. I similate an attitude of anger. My demeanor is more alarming to the child than the contemplated dental service about which he is concerned. He accepts the service as the lesser of the two evils; and, if the service is administered with proper consideration, his gagging is less apt to be used as a defense mechanism the next time.

Heredity: As the apple "does not fall far from the tree," so too the teeth of the child have a remarkable tendency to look and be like the teeth of the child's forbearer.

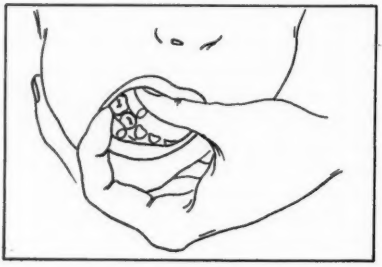
It has amazed me at times just how closely the teeth of the child and parent do resemble each other. They tend to assume the same position and the same shape, to take the same color, and to have the same susceptibility or immunity to caries or periodontoclasia; and they actually break down in the same way.

Further, certain teeth in the permanent set seem to follow the same tendency as similar teeth in the primary set. This is an important fact to note. Thus, if teeth break down quickly in the primary set, look for this to happen in the permanent set. It generally does.

For illustration, if the primary cuspids and molars have a tendency to cervical break-down, you can expect this to occur similarly with the corresponding permanent teeth. If the primary second molars are lost prematurely because of large occlusal cavities, catch the permanent first molars as soon as they emerge through the gums, and fill the pre-carious fissures. These cavities are sometimes mighty large even at this early stage.

Cotton Rolls: Since cotton rolls are such an important adjunct to service for

Holding Cotton Rolls
(without an assistant)



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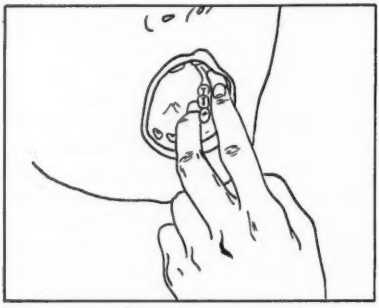

For the lower left.

FIG. 35. Holding cotton rolls—right side
FIG. 36. Holding cotton rolls—left side

children, their proper choice, preparation, and management can save the dentist inconvenience and time.

For children's operative service, I generally prefer size # 2 rolls cut into $\frac{3}{4}$" lengths. For older children, I prefer using two or three of these, one above the other, rather than the thicker #3 roll.

Some dentists find it necessary to have an assistant to help them hold the rolls in place. I tried this and found it both a nuisance and time-consuming. The rolls can easily be held in place in the lower jaw (Figures 35 and 36). There is no problem with the upper jaw. Automatic mechanical holders have proven of no value for small children; and, with rare exception, they continue to grace my cabinet drawer. I find little use for them.

While cement is setting, it is of considerable advantage to have the child hold the rolls in place with his finger. It not only helps me, but puts the child in the position of doing the work rather than merely submitting to it; thus it helps psychologically also.

Less Pain with Children: It would seem to me that there is less pain experienced by the patient in the preparation of primary and young permanent teeth than by the adult. Perhaps this is because the relatively large blood supply tends to reduce and more quickly relieve the vascular congestion produced by heat and instrumentation. Sharp burs and diamond stones are essential to keep the heat produced during cavity preparation at a minimum.

Enlarged frenum: I have never seen a patient where excision of an enlarged frenum seemed justified. It is generally severed either in the process of natural growth when the laterals and cuspids erupt; or in the course of orthodontic correction simply by bringing and maintaining the central incisors in mesial contact.

CHAPTER XX

Special Considerations

"More Capsule Comments"

Instruments: The fewer instruments I employ—the more simple the equipment I use, the better satisfied I am. It tends to quicker results. The fewer the instrument changes, the less apprehension is created in the child's mind.

With each instrument I use, I carry the child through a brief, almost imperceptible, period of conditioning. My first strokes with a bur are short; my first pressure, light. Since some time is consumed in this conditioning process, the fewer the instrument changes and the more double-end, double-duty instruments I can use, the more effective I find my service.

I am willing to sacrifice the final grain in efficiency of cavity preparation, filling, extraction, or any other phase of pedodontic service for the benefit of having an infinitely happier patient or a more completely satisfied parent.

Child management: Management of a child after his first trip is easier if the operator and the nurse do a minimum of visiting with the child. Questions that are asked by the child with the idea of putting the dentist on the defensive are ignored. It is a good policy to have the patient help the dentist as much as possible. Let him hold the air line. Let him hold the cotton rolls in place in his mouth while the cement is setting. Keep his hands occupied—it helps immeasurably.

It is most essential to good operative procedure to seat the child correctly in the dental chair (Figure 37). Unless his body is planted firmly against the back of the chair, his head will not be positioned correctly. Here is a simple sugges-

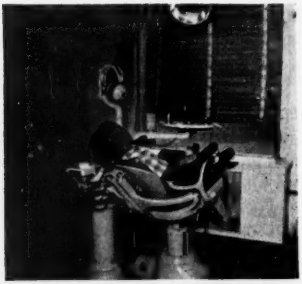

FIG. 37. Child correctly positioned in dental chair

tion—it is more important than you may think in managing the child and in doing good dentistry for him. Be certain that his feet are on the foot-rest. Be sure that his hands are on the arm-rest. Be sure that his back is against the chair's back-rest.

Open your mouth: The need for repeating the statement, "open your mouth," is indication that one of several things is wrong.

Generally, and part ɔularly with the small patient three to six, it is due to one of three things; willful lack of patient cooperation, improper positioning of the head-rest, or improper conditioning of the child. With few exceptions, proper attention to the first two points eliminates this difficulty.

If the child is apprehensive, he will tend to keep his mouth closed or opened only slightly. Running the bur or instrument lightly over the front teeth relieves his apprehension, and he then responds to a light pressure or casual direction to open his mouth.

Saving Time: Running the engine just a little faster, bearing down on the bur just a little more to save time is false economy.

Soon after beginning service for children, I cultivated the habit of using a moderate engine speed and the slightest pressure possible to obtain effective results. In performing several gratis services for adults, they invariably commented on my "noiseless" engine or light touch.

This focused my attention on what has developed over the years to be a very important factor in satisfying children. The child has difficulty differentiating between pressure and pain. I have had children flinch, under test conditions, at pressure on the surface of a sound tooth; yet never waiver when I was drilling lightly and carefully with sharp burs not too very far from the horn of a pulp.

The same is true of speed and noise. The whirring of an engine cord can upset a child when absolutely no pain has been inflicted. So keep the engine speed moderately slow and the pressure light—especially for small children.

Bur Reception: The easiest method of entering a cavity, in my experience, is through the use of a 33½ inverted cone bur worked in an occlusal pit. This is followed by the use of a 35 a 37 and a 39 inverted cone.

This will suffice where the tissue is relatively clean. If caries remains, I then use a # 8 round bur.

FIG. 38. Placing small amount of cement

Children react most favorably to the smaller size burs and to round burs.

Handling Cement: One of the most difficult operations of my early practice was the proper placement of cement. The cavity preparations in primary teeth were so small that it was difficult to place a tiny bit of cement at the proper spot.

If the cement is stiff yet workable and if the small amount desired is rolled on the napkin, it can easily be picked up on the point of an instrument and placed exactly where it is wanted (Figure 38). It still has enough plasticity at this point to permit its being molded to place and properly shaped.

Occlusal cavity width: It was my procedure in the first several years of practice to make the occlusal width of some cavities as narrow as a 35 inverted cone. Time showed that a wider filling finishes and holds better even in simple occlusal cavities. If the mouth immunity is better than average, I may hold the width down to a 37 bur. Generally, however, I find that a filling at least the width of a 39 bur lends itself better to finishing and to permanency.

Caries—origin and progress. Technically dentistry's simplest and certainly one of its most effective contributions to people's health and welfare occurs in the correction of occlusal and proximal caries *when first detectable* (Figure 39 (2)).

A knowledge of the essential difference between the picture of a groove (normal) and that of a fissure (potentially destructive) is welcome information to the parent. The fact that fully nine out of ten permanent first molars *erupt* with *fissures* that require *immediate* correction is always a surprise to parents. The reason, of course, is not parental neglect or oversight anywhere along the line. Rather, the fact is that evolution has conspired with environment to produce the condition.

Unfortunately these fissures are sometimes so large that, unattended, one first permanent molar out of four is apt to be lost within the first year after eruption (Findings of the Forsyth Infirmary for Children).

Visit planning: After the first visit during which a prophylaxis is given and x-rays taken, I generally plan to perform the child's dental services in quadrants. At the second visit, I might do the left upper and lower quadrants leaving the right upper and lower for the next visit. If the caries is more advanced, I might complete just one quadrant selecting the easiest for the first trip following the prophylaxis visit—unless attention to another area is more urgent. The lower

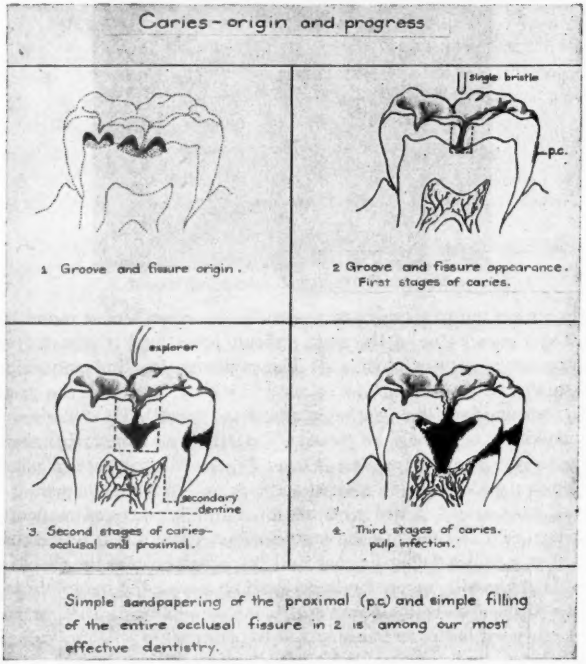
Caries - origin and progress
1 Groove and fissure origin.
single bristle
p.c.
2 Groove and fissure appearance. First stages of caries.
explorer
secondary dentine
3 Second stages of caries— occlusal and proximal.
4. Third stages of caries. pulp infection.
Simple sandpapering of the proximal (p.c.) and simple filling of the entire occlusal fissure in 2 is among our most effective dentistry.

FIG. 39. The story of caries

teeth seem to have larger cavities than the upper. I generally care for these at one visit anesthetizing the entire mandible.

Prenatal influence: I have rarely seen signs of prenatal disturbance manifest in the primary set. Nature protects the foetus. Schour did demonstrate that each primary tooth has a neo-natal line. It seems the enamel formed after birth may be affected by any condition or disease that affects the skin inasmuch as the enamel too is of ectodermal origin.

Recall: We tried sending post card reminders to our recall patients each six months. These simply stated that the time had arrived for the parent to phone for an appointment. Parents would postpone doing so then criticize the office for not being more definite. We began to place these reservations—even six months in advance—on the appointment book at a specific time. About a week prior to their scheduled appointment, we call to remind the parent.

The unusually difficult child: Management of a difficult child is easier if the parent is sent from the treatment room. This gesture and a firm manner is often all that is needed. If the child persists in being recalcitrant or hysterical the palm of the left hand is placed firmly over the child's mouth. The child's hands are

controlled by the operator's right hand. When the child agrees to cooperate, the hand is removed. This may need to be repeated. When it is repeated, the dentist makes his treatment and manner more severe.

This procedure "turns the trick" with the large majority of the more difficult children. We use it only as a final resort convinced that the more we use our head, the less we need to use our hand.

CHAPTER XXI

Conclusion

"Only As Children Excel . . ."

MY OBSERVATION has been that there is more dentistry needed for children today than there was twenty years ago. Perhaps more dentistry is needed for the average adult also. If we go back far enough, several hundred years, teeth were admittedly very much better than they are at present. Our grandparents reported a good number arriving at a ripe old age with all their teeth. Some had no fillings. It seems to me that today's adult population presents a less favorable picture.

Yet, the average adult reports that his dental troubles did not begin until he was ten or twelve years old. Today's children need some emergency service before they are six years old. In fact, when children are brought to the dentist at two and a half to three, as we recommend, fully one-third of them already have cavities.

My impression is that whatever is causing cavities, it is more active today than when I first started in practice.

I do think that more dentistry and better dentistry is being performed for children today than was the case twenty years ago. Credit for this in a large part is due to the fine work of our dental colleges. True, there are not enough pedodontists. That is, perhaps, because pedodontics, unlike other specialties, has no large fees to bolster the dentist's income. Dentistry for children is bread and butter dentistry. Small, steady fees prevail. That is why it fits so well into general practice.

To illustrate this point further, there are just a few more simonpure pedodontists in the American Society of Dentistry for Children today than at its inception by fifty-four dentists twenty-seven years ago. Yet, the ready increase of this society to more than three thousand attests to the family dentist's growing interest in children.

During the last depression, dentistry for children was the "heart-beat" of many a general practice that might otherwise have stopped. The practices that were hardest hit were the practices that catered only to adults. These were the last to get back on their feet when recovery came. The childless practice may be doing all right today, but these are lush times. Look ahead!

Children shout your praise from the house tops. No better boosters, no more loyal patients, and no more ardent friends exist. Properly performed, no part of a general practice is more valuable, no part is more pleasant nor more soul-satisfying to the dentist than dentistry for children.

This is the dentistry where dentistry counts most. Properly practiced, it makes the dentist's living fuller; it makes the patient's living happier, it make-tomorrow's world better—for children improve it. Our contribution to civilization has its greatest promise in our work for these little people. Dentistry's goal for the future, dentistry's key to its rightful place in the sun lies in more and better service for children.

Your Comment Page

1. Questions:

2. Comments.

3. Practice Hints:

FROM:

Please mail to: Dr. Sam Harris, 2312 Broderick Tower, Detroit 26, Michigan

Sealing Qualities of Various Filling Materials

MAURY MASSLER, D.D.S., M.S. AND ABRAHAM OSTROVSKY, D.D.S.*

INTRODUCTION

IT HAS been shown that when freshly cut dentin is exposed to the action of saliva after cavity preparation, excessive injury to the pulp results (Van Hyusen and Gurley, 1939; James and Diefenbach, 1942). The ability of a given filling material to seal the cavity preparation against salivary contamination is therefore an important requirement of that material.

The purpose of this study was to determine the relative sealing quality of a number of commonly used filling materials under controlled conditions, in vitro.

REVIEW OF THE LITERATURE

There have been only a few controlled studies made to determine the marginal sealing qualities of various filling materials. Grossman (1939) tested the sealing properties of materials commonly employed as sealing agents during root canal therapy (baseplate gutta percha, temporary stopping, zinc oxyphosphate cement, zinc oxide and eugenol, and a combination of these materials). The filling materials were placed in one end of thin capillary tubes (roughened on the inside) and suspended in an aqueous dye solution. A duplicate set of tubes were also placed in a combination of saliva plus dye. Grossman found that zinc oxide and eugenol was the only material that showed no leakage. Zinc oxyphosphate cement was the least effective sealing agent with gutta percha in an intermediate position.

Fisher (1949) made a careful and extensive investigation of the sealing qualities of various filling materials by filling 90 freshly extracted teeth and 60 teeth which were going to be extracted, with zinc oxyphosphate cement, copper cement, silicate cement, amalgam, inlay, foil or acrylics polymerized outside and inside the cavities. He found that every filling material allows a certain amount of fluid penetration along the margin. The acrylic resins (especially the self-curing acrylics) showed the poorest sealing quality.

Buchanan (1951) used a method similar to that used by Grossman as well as freshly extracted teeth. He reported that self-curing acrylics showed better sealing qualities than did silicate cements.

Fiasconaro and Sherman (1952) used extracted molars to test the sealing qualities of gold foil, inlay, amalgam, silicate cement, zinc oxyphosphate cement and a variety of self-curing acrylics. They sealed a tube into the pulp chamber, immersed the tooth under water and determined the amount of air pressure necessary to break the seal as evidenced by the appearance of an air bubble at the cavosurface margin of the filling. They found that the acrylics leaked at 6–8 pounds pressure, silicates leaked at 38 pounds, inlays at about 45-50 pounds, while amalgam, gold foil and zinc oxyphosphate cement did not leak at their maximal limit of 50 pounds of pressure per square inch.

The contradiction in the results obtained by Buchanan and by Fiasconaro and Sherman in regard to the sealing qualities of the acrylics is difficult to explain.

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Armstrong and Simon (1951) filled buccal class V cavities in eight freshly extracted lower second bicuspids with amalgam, gold foil, gold inlay, oxyphosphate cement, silicate and self-curing acrylic. The roots were covered with wax and the crowns were immersed in a solution of radioactive calcium for 48 hours. Sections were made through these specimens and radioautographs prepared. It was found that radiocalcium penetrated the margins of all the filling materials used but to different degrees.

Nelsen, Wolcott and Paffenbargar (1952) used an ingenious method to demonstrate the role of thermal expansion in causing fluid exchange through the margins of dental restorations. Extracted teeth were filled with self-curing acrylic resins, chilled in ice water for 30 seconds, wiped dry and viewed under a binocular microscope while the tooth was warmed with the fingers. Small droplets of fluid exuded from the margins of the restoration as the tooth warmed. They concluded that this marginal percolation was caused by differences in the thermal expansion of the tooth and the restoration and by thermal expansion of the fluid occupying the crevice between the tooth and the restoration. They found incidentally that amalgam, gold inlay, silicate cement, gold foil, gutta percha and zinc oxide eugenol cement restorations in extracted teeth also leaked when they were subjected to cooling and warming.

It is evident that none of the filling materials in use today shows perfect marginal sealing against the ingress of fluids. Some, such as the self-curing acrylics, are obviously inadequate in this respect yet enjoy widespread clinical use. Others are relatively better but there seems to be little agreement as to how much better they are or even whether they are clinically acceptable. The purpose of this study was to determine the *relative* sealing quality of a number of commonly used filling materials under controlled conditions, in vitro. It is hoped that the results will serve as a basis for future objective clinical evaluation of these materials.

Methods and Materials

Glass tubes with an inside diameter of 5 mm. were used in this study as cavity models into which the various materials were placed for testing. A tightly fitted glass rod was inserted into the tube leaving a cavity exactly 5 mm. deep and 5 mm. in diameter. The filling material

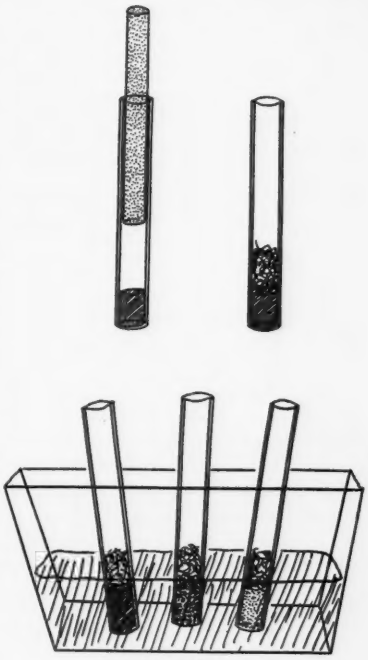

Fig. 1

TABLE 1

Time required for dye to penetrate through margins of various filling materials placed in glass tubes

Material Tested	Procedure*	Time Required to Penetrate Through Margins†
Baseplate gutta percha	A. Gutta-percha heated and packed under extreme pressure	5–30 min.
	B. Packed and allowed to cool. Test cylinder removed, wet in eucalyptol and replaced in cavity under pressure	½–17 hrs.
	C. Cavity wet with chloro-percha before packing with heated gutta-percha	4–13 hrs.
Temporary stopping	A. Heated and packed under maximal pressure	2–4 hrs.
	B. Heated and packed under moderate pressure (as in mouth)	2–4 hrs.
	C. Heated and packed as in B. but overhangs over margin of cavity not removed	17–40 hrs.
Zinc oxyphosphate cement	A. Thin mix inserted under pressure and allowed to set for 4 min. before immersion in dye solution	5–30 min.
	B. Thin mix inserted under pressure and allowed to set for 5 min. before immersion	30–90 min.
	C. Thick mix packed under pressure and allowed to set for 4 min. before placing in dye solution	30–90 min.
	D. Thick mix packed under pressure and immersed in dye solution before setting	30–90 min.
	E. Thick mix packed under pressure and allowed to set for 5 min. before immersion in dye solution	10–30 min.
Self-curing acrylic	A. Mixed outside cavity and inserted under pressure. Immersed in dye solution after setting	5–20 min.
	B. Mixed outside cavity and inserted under pressure. Immersed in dye solution before setting	20–60 min.
	C. Painted into cavity in layers. Allowed to set completely before immersion in dye solution	3–22 hrs.
	D. Painted into cavity in layers. Immersed in dye solution before setting	10–40 hrs.
Silicate cement	A. Careful mix on cooled slab, inserted and allowed to set for 4 min. using celluloid strip under pressure and covered with cocoa butter	½–13 days
	B. Mixed and inserted into cavity. No celluloid strip or cocoa butter used. Immersed into dye solution before setting	½–3 days
Inlay	Wax pattern taken directly and cast. Cemented using zinc oxyphosphate cement, allowed to set and immersed in dye solution	90–120 days

TABLE 1—*Cont.*

Material Teted	Procedure*	Time Required to Penetrate Through Margins*
Zinc-oxide and eugenol	A. Thick mix packed under pressure. Immersed in dye solution immediately B. Thick mix, cotton fibers incorporated, packed under moderate pressure and immersed in dye solution immediately C. Thin mix with 1% zinc acetate added. Packed and immersed in dye solution immediately	Dye penetrated only 2-3 mm. along margin after 120 days
Amalgam	A. Mixed and inserted as per mfg. instructions using hand pressure. Allowed to set for 10 min. before immersion in dye solution B. Mixed and inserted as above but immersed in dye solution before setting C. Contaminated with saliva during mix, manipulated with fingers and immersed in dye solution before setting	No sign of any penetration after 180 days

* Overhang and overlap removed from cavity margin unless otherwise noted.
† Range of 12 trials made by three different investigators.

was packed inside this cavity so that each test sample was a cylinder exactly 5 mm. in diameter and 5 mm. in length. The glass rod was then removed and a cotton wick was packed lightly above the filling to act as an absorbent for the dye and indicator (figure 1).

The filled ends of these tubes were placed in solutions of gentian violet 0.025% or methylene blue 0.25% to a depth of 20 mm. The tubes were examined periodically. The end point noted was when the cotton wick just began to stain.

Each material was mixed and packed according to the manufacturer's recommendations. In addition, each procedure was varied in separate tests to conform with common clinical procedures, i.e. immersed in the dye solution before setting or deliberately contaminated during manipulation of the material (see table 1).

In each series, at least 12 trials were made by 3 different investigators in order to eliminate individual peculiarities in the handling of the materials.

Findings

Table 1 indicates the range of time within which the margins of the eight filling materials tested were penetrated by the dye solutions under the conditions of this test.

These data indicate that baseplate gutta percha, temporary stopping, zinc oxyphosphate cement and self-curing acrylics are not effective sealing agents since the dye solution penetrated through the margins of the 5 mm. test cylinder within a few minutes or hours after insertion of these materials into the test cavities. Silicate cement was only slightly more effective, providing an effective seal (under optimal conditions) for 12 hours to 13 days. Amalgam, gold inlays cemented with zinc oxyphosphate cement and zinc oxide and eugenol cement withstood marginal penetration of the dye solution for much longer periods (more than four months) when compared to the others.

Although these results cannot be transferred directly to actual clinical condi-

tions of use, they do indicate the *relative* sealing qualities of these materials and thus provide a basis for comparisons and further investigations. The comparisons are most revealing.

The baseplate gutta percha was heated until very soft and packed into the glass cavity under pressures much greater than could be achieved clinically. The material was held under pressure until thoroughly cooled before immersion into the dye solution. Nonetheless, gutta percha failed to seal effectively for more than 5 to 30 minutes. The marginal failure was undoubtedly related to the extreme shrinkage of the material during cooling—in spite of the pressure exerted. Since this test provided more favorable conditions for sealing than could be achieved clinically and omitted the intra-oral variations in temperature and forces of mastication, the effectiveness of this material as a temporary filling material is questionable.

Wetting the gutta percha with a solvent (eucalyptol or chloroform) greatly increased the sealing quality of this material (from a maximum of ½ hour to a maximum of 17 hours) (table 1).

Temporary stopping (a mixture of zinc oxide filler in a gutta percha base) provided a more effective seal against the dye solution (2 to 4 hours) than did the baseplate gutta percha. This was probably related to the lesser amount of heat necessary to soften the temporary stopping and resulted in less shrinkage. This advantage is probably outweighed clinically by the fact that this material is much softer and more easily distorted under masticatory forces than is the baseplate gutta percha. Neither material can be said to provide effective marginal sealing under the conditions of this test.

Zinc oxyphosphate cement failed to seal the glass cavity against the dye for more than 90 minutes. The density of the mix (thin or thick) did not seem to have a marked influence on its sealing quality. It was interesting to note that immersion in the dye solution before the final set of the cement did not greatly affect the sealing quality while excessive drying after the set apparently caused greater shrinkage of the material and opened its margins quickly (table 1). Zinc oxyphosphate has the clinical advantage of being less liable to distortion by masticatory forces than gutta percha but its marginal sealing quality is even less satisfactory than the former under the conditions of this test. This study confirms Grossman's contention that zinc oxyphosphate cement is not a satisfactory material for sealing during endodontic procedures.

Tests using a self-curing acrylic resin (K) showed that this material, too, has very poor marginal sealing qualities. When mixed outside the cavity and inserted under extreme pressures and optimal conditions of setting not easily duplicated clinically, the margins of 5 mm. test cylinders of this material were penetrated by the dye in 5 to 20 minutes. Surprisingly, better sealing was achieved when the material was placed in the dye solution before setting completely. This probably is due to water absorption and swelling of the material so that the margins are sealed more tightly.

Use of the brush technique instead of the pressure method increased the maximal effective sealing time from 20 minutes to 22 hours. Here again, allowing the material to become wet before it was completely set improved its sealing quality to a maximum of 40 hours (table 1). Under clinical conditions, this maximum can hardly be called satisfactory.

Silicate cement provided a much longer marginal seal (½ to 13 days) than did any of the previous materials tested, when

inserted in the glass cavity under optimal conditions. The marginal seal was penetrated much more quickly (in 12 to 72 hours) when the material was not handled according to the manufacturer's specifications (table 1).

Inlays cemented into the glass test cavity with a thin mix of zinc oxyphosphate cement showed much greater marginal sealing (3 to 4 months) than did the zinc oxyphosphate cement when the latter was used in bulk. The thin layer between the metal and the glass was probably not subject to the same shrinkage as was the material in bulk. All metal overhangs were carefully removed and the margins were not burnished. The marginal seal of the inlays was greatly superior to the silicate and oxyphosphate cements.

Zinc oxide and eugenol provided an excellent marginal seal against the ingress of the dye solution. After four months (when the program was terminated), the dye had only penetrated 2 to 3 mm. along the 5 mm. wall of the test cylinder and appeared to be stationary there. This confirms Grossman's observation that this material is the best available to seal cavities effectively during endodontic procedures.

Amalgam showed the best marginal seal of all the substances tested. Deliberate mishandling and contamination of the material during trituration and insertion still resulted in an effective marginal seal when the experiment was terminated at the end of six months. At this time the dye had penetrated less than 0.1 mm. along the wall of the test cylinder.

Effect of Overhang. In a supplementary series of tests, each one of the materials was permitted to overlap the margins of the glass cavity instead of being trimmed as was done in the series tabulated in table 1. This procedure greatly increased the time required for the dye solution to penetrate along the margins. Gutta percha, temporary stopping and the self-curing acrylics provided an effective seal against the dye solution for 2 to 20 days when the overhang was not removed as compared to a maximum of 4 hours when the overhang was removed. Although these results are suggestive, they are of questionable value since the sealing action by the overhang is quickly distorted and destroyed under occlusal stresses under clinical conditions of usage.

Discussion

It is clear that the conditions of this study did *not* duplicate actual conditions of clinical usage. This study attempts only to provide relative data under standardized conditions, in vitro, for purposes of comparison.

This test did not take into consideration (1) the higher viscosity of the saliva over the aqueous dye solution (2) the relatively roughened surface of the average cavity preparation in enamel and dentin as compared to the glass cylinder and (3) the much higher temperature and temperature variations of fluids in the oral cavity. As shown by Grossman (1939), the viscous saliva does not penetrate as readily as the aqueous dye solution, between filling material and wall of the cavity preparation. The microscopic irregularities in the enamel and dentin of the cavity preparation would hold the filling materials much more tightly than the smooth glass walls of the test cylinder and thus further prevent seepage by the dye solution. On the other hand, the margins of filling materials used in vivo are undoubtedly subjected to much greater stresses by the great variations in intraoral temperatures (Nelsen, Wolcott and Paffenbarger, 1952) and by the forces of mastication.

Thus, while the conditions of this study do not duplicate actual conditions of clinical usage, the results are highly suggestive and should be seriously considered by the clinician.

Summary and Conclusions

The sealing qualities of various filling materials were tested in vitro in glass "cavities" under controlled conditions. It was found that even under ideal conditions marginal leakage occurred within 24 hours when baseplate gutta percha, temporary stopping, zinc oxyphosphate cement and self-curing acrylic resin were used as fillings. Silicate cement preserved its marginal seal somewhat longer (up to a maximum of 13 days). The margins of inlays cemented with zinc oxyphosphate cement remained intact under these conditions for 90 to 120 days. Zinc oxide and eugenol and amalgam showed the most effective marginal sealing qualities.

These results confirm Grossman's (1939) report and those of others that the commonly used filling materials exhibit marginal leakage in a relatively short period of time and that zinc oxide and eugenol and amalgam are the most effective sealing agents.

These tests were not intended to simulate actual clinical conditions. It is believed that the sealing qualities of these materials may be less effective when used in vivo since the margins of restorations are subjected to stresses arising from differences in the coefficients of thermal expansion as demonstrated by Nelsen, Wolcott and Paffenbarger (1952) and from the forces of mastication.

Acknowledgment: The assistance of Drs. H. L. Bhatia, S. Vazirani, F. Ehrlich and R. Ciocon in gathering and checking the data obtained in this study is gratefully acknowledged.

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Oral Manifestations of Systemic Disease

ROSA LEE NEMIR, M.D.*

EXCHANGE of professional knowledge reveals the pedodontists' intense efforts to understand the whole child even though you are asked to deal with only a small part of that person. Pediatricians, in like manner, at a national meeting of the American Academy of Pediatrics, devoted an afternoon to the study of children's dental problems as seen by the dentist. We need to pool our knowledge and work together as a team.

The experienced, quick eye of the dentist sees at a glance asymmetry of the face representing any one of the following: congenital malformations of bony structure; enlarged lymph nodes associated with local dental or gingival infection, or as a part of general systemic maladies. The dentist knows, too, that cysts and tumors may masquerade beneath this apparently innocent swelling. Careful examination of the oral cavity sometimes answers the problem. The pallor of the mucous membranes may suggest a blood dyscrasia or tumor mass, or the localized lesions of gums or teeth may explain the swelling. Sometimes, the dentist has the misfortune to examine a young patient whose early onset of measles with Koplik spots may be the tell-tale sign.

Whatever the finding, quickly the experienced eye appraises the color of the mucous membranes, whether pale, inflamed, cyanotic, the yellow tint of jaundice, or the discoloration of drugs or metals such as lead or iron. The state of health of the mucous membranes of the oral cavity and congenital anomalies of palate, tongue, and teeth are appraised. The mucous membranes of the mouth are the most accessible and visible areas for examination of such tissues; when lesions are seen here they often represent only one manifestation of mucous membrane pathology; as in Herpes, Varicella and secondary syphilis in which vulvar lesions may also be found.

One might now pose the question: What factors are responsible for the pathology in the oral cavity?

Clearly the answer must include factors operative in fetal life as well as those occurring at varying times in post-natal life. The embryo at eight weeks of age is already beginning the development of teeth, and shortly thereafter the development and differentiation of the various facial structures take place. Various abnormal factors operating at the crucial moment of the development of these young tissues may produce an arrest of growth. Thus, the virus of rubella may pass through the placental barrier early in the life of the embryo and, depending on the stage of the developing tissues, result in various anomalies. When the embryo is approximately six weeks of age, such malformations as cataract of the eyes and congenital heart disease may be seen; if the embryo is eight weeks or more, deaf-mutism may occur and other anomalies among which are those of the teeth (as described by Evans (1) of Australia) such as enamel hypoplasia and pointed incisors, delayed eruption of teeth and caries.

Known factors responsible for fetal arrest of growth or anomalies may be

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listed as profound disturbances in maternal nutrition, trauma, hemorrhage, or partial interference with circulation, irradiation of the fetus, and, most commonly, infections. The latter, if severe, produce death of the fetus; when milder, they may produce anomalies. These infections may be viral, as in rubella, epidemic parotitis, varicella or influenza. They may be spirochetal, as in syphilis, or bacterial, as in scarlet fever and endocarditis. Finally, hereditary factors affecting tissue growth must be mentioned.

In all instances the effect on structures may not be apparent at birth and may appear at varying times in post-natal life. The famous Hutchinson teeth, the sharp conical incisors, so often related to congenital syphilis, although probably not solely due to syphilis, are the permanent incisors and, hence, not seen until after five years.

The experimental work of Warkany on pregnant rats deserves mention. Under controlled conditions, Warkany (2) studied the effect on the offspring of such factors as feeding the pregnant mother diets deficient in Vitamin A, or riboflavin and the effect of x-ray radiation at varying periods in fetal life.

Numerous anomalies resulted. It is significant that the same anomaly, for example, cleft palate and lip, might be produced by different forms of interference with growth, namely deficiency of Vitamin A, or riboflavin, or exposure to Roentgen rays. There were also strains of rats in whom these defects appeared to be hereditary.

Greenish-yellow discolorations of the primary teeth and defective enamel have been noted associated with severe erythroblastosis fetalis. Two such cases were reported by Tank (2).

Turning now to the factors affecting oral tissues in post-natal life, one finds similar ones. Those of nutrition, infection, blood dyscrasias, tumors, and drug and metal poisoning.

The nutritional deficiencies of various vitamins and minerals are well known to you. It is uncommon today to see patients with scurvy, and yet, bleeding gums may still be seen in those children whose intake covers only minimal requirements and cannot meet the additional need required during infections and febrile illness. Infantile scurvy, although uncommon, may still be seen between the ages of six to eighteen months.

We have all observed Vitamin B oral lesions, whether a deficiency of niacin or riboflavin, such as the smooth eroded tongue, or the hypertrophoid papillae, deeply furrowed and swollen resembling the geographic tongue. Cheilosis is most common in the southern areas of this country. When seen, a correction of the diet with reference to the vitamin B intake should be made. Dental procedures are obviously more successful in the presence of healthy tissue. Correction of the diet in terms of vitamins and minerals (especially iron, iodine and calcium) means a healthier child and a healthier oral cavity.

A word may be added concerning the role of rickets in our locale. For many years I have been observing patients from sections of New York where we might expect to see Vitamin D deficiency and yet, patients with active rickets and rachitic deformity, due to deficient intake, are uncommon today. But, delayed eruption of primary teeth, as well as eruption out of the usual sequence, have been reported in severe rickets. Defects in enamel, both in the primary and permanent teeth, have been attributed to active rickets existing at the time of the formation of the enamel of teeth involved.

A word concerning vitamin deficiency may be in order at this point. It is not enough to know the vitamin intake of a patient. It is essential to consider such factors as vitamin requirements, which may be increased during growing periods, during infections or fevers, and further to consider such factors as vitamin absorption and vitamin loss, as well as the type of diet, especially with reference to protein intake. It is well known that there is Vitamin B loss during diarrhea. Moreover the changed bacterial population results in loss of the natual biosynthesis of Vitamin B produced by these normal intestinal bacteria. Most of these factors are responsible for the oral lesions seen in coeliac syndrome where the lesions are thought to be secondary to a Vitamin B deficiency and to respond to Vitamin B therapy.

Lesions of the oral cavity are seen often during infections in children. The acute contagious disease may have pathognomonic signs in the mucous membranes, for example, Koplik spots of measles. Other findings may be the strawberry tongue of scarlet fever, the occasional vesicles on the mucous membranes in varicella and the swollen Stenson's duct in epidemic parotitis.

Systemic diseases such as subacute bacterial endocarditis, meningococcemia and purpura may produce small hemorrhagic areas on buccal mucous membranes and palate. These are sometimes the early signs of blood stream invasion, and hence their observation is of the utmost importance.

Recently emphasis has been given to herpetic lesions of the oropharynx. Dodd (3) and co-workers in 1938 first associated the ulcerations in the mouth with the herpes virus. Later Scott (4) and others described more fully this acute infection of children between one and six years of age, characterized by high fever, sore throat and sore mouth. The chief lesions of this infectious herpetic gingivostomatitis consist of a fiery red gingiva, multiple small ulcers upon the tongue, in the soft palate and other parts. Earlier the small vesicles preceding the breakdown into ulcers may be seen. Ulcerations commonly appear around the gingival tissue of partially erupted teeth. Viral studies and immunological tests have clearly incriminated the herpes virus as the etiologic agent. Penicillin lozenges are contraindicated.

In patients with blood dyscrasias, such as the purpuras, anemias, and with neoplasms, and leukemias the lesions occur often in ambulatory patients and are sometimes seen by the dentist before the systemic disease is diagnosed.

Further recounting of cause and effect will not be necessary. This sketchy review has indicated the importance of appraising lesions in the oral cavity in terms of the whole child and the value of team work between dentist and physician.

Briefly, chronic diseases such as bronchiectasis, coeliac syndrome or cystic fibrosis of the pancreas, tuberculosis, nephritis or diabetes would appear to affect the oral cavity by changing the physiology, chemistry, nutritional balance and bacterial flora of the mouth and hence their results are secondary. In like manner, drugs of various sorts leave tell-tale marks in the oral cavity. The hypertrophied gums after long administration of dilantin for epilepsy, and the hairy tongue associated with prolonged penicillin therapy are examples. New signs will come to light with our constantly changing antibiotic therapy. We need to be on the alert.

Finally, a comment must be made concerning the relation of the existing systemic disease in the patient and dental

therapy. Great caution must be exercised wherever there is unhealthy oral tissue. Hemophilia, as a possible cause of bleeding before dental extractions, must be considered. Furthermore, in conjunction with the pediatricians, penicillin must be given by special schedule before extracting the teeth of patients with rheumatic fever or congenital heart disease. The question of poliomyelitis and its relation to exodontia naturally arises. There are reports of several single instances of acute poliomyelitis immediately following dental procedures. However, there is no statistical evidence to establish a causal relation. From the experience with tonsillectomies and the onset of bulbar poliomyelitis, it seems wise to advise that elective exodontia be postponed during the poliomyelitis season. On the other hand it is possible that severe dental caries may furnish a portal of entry for the polio virus. Investigation in this field is needed.

Recently, a four year old white boy was admitted to University Hospital with the following story: Two weeks prior to admission, the patient lost a lower tooth and afterwards the mother noticed a swelling on the floor of the mouth. The oral surgeon consulted, advised surgical removal of the mass. Consultation with a second oral surgeon led to a study of the jaws by x-ray and to the discovery of many cystic lesions in the maxilla and mandible. The child has, since birth, had puffy cheeks, and the mother has noted that he keeps his mouth open most of the time. A diagnosis of fibrous dysplasia (5) of the mandible and maxilla, a congenital disease sometimes called "Cherubism", was made. X-rays of the bones were shown to demonstrate the multiple cystic lesions.

The experience with this patient illustrates the importance to the dentist and patient of the appreciation of and appraisal of the oral manifestations of systemic disease.

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A Simplified Matrix Technique

FLOYDE E. HOGEBOOM, D.D.S., F.A.C.D.
Los Angeles

WHEN preparing a Class II cavity it is usually necessary to place a matrix on the tooth. It is not quite so easy to place a matrix on primary teeth as on permanent teeth, particularly the first primary molars because of the bulge at the gingival. The matrix slips off and is very difficult to hold in place. A number of years ago, I came to the conclusion the most efficient matrix to be used and the most practical was the spot welded matrix of chrome steel. We have been using it routinely.

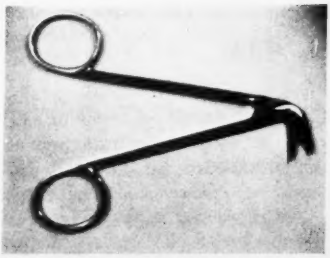


FIG. 1

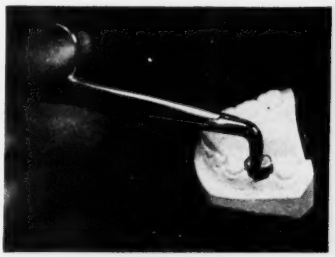


FIG. 2

Take a piece of stainless steel or chrome alloy about $\frac{3}{16}$th of an inch in width and fashion it around the tooth and pinch it on the buccal. One of the easiest ways to do this is to take an approximate size matrix material and spot weld the two ends together. With pinching pliers, and after it is snugly fitted to the tooth, pinch the band on the buccal, remove, and put three spots fairly close to the bend, not right up tight, but just a little bit away from it. The matrix band can be further festooned and placed on the tooth.

It is true that on the second primary molar that a matrix such as the Steele's or the Tofflemire can be used very easily. Frequently, on the lower first or second molar when using cotton rolls the child raises his tongue or the cotton roll holder moves up and knocks the handle of the matrix holder, loosening the matrix band. We have found that the use of the spot welded matrix saves a good deal of time and can be done neatly and fits the tooth snugly.

After the filling has been placed and left to harden for a few minutes, take a pair of right angle scissors and cut behind the spots and the band immediately opens up. The ordinary crown and bridge scissors do not meet the conditions because of the interference of the lips. We have been looking for sometime and finally found the type of scissors that meet our needs. We attempted at first to have the scissors made, but found that it was difficult to do so and in the meantime we found what we wanted, made by a European company. The No. 13 right angle scissor that can be secured from the

Rocky Mountain Metal Products Co. fits the need.

Figure 1 shows the scissors open. They slip in very nicely under the cheek and parallel with the jaw. The right angle permits cutting close up to the band without cheek distortion.

Figure 2 shows the matrix in place and the scissors held in position to cut the band.

The spot welded matrix band is a very practical and efficient way of overcoming the usual handicaps of the primary anatomy and with the availability of the right angle No. 13 matrix scissors, the problem of removal is simplified.

Unit News

Arkansas

At the time of this report "Operation Bitewing" is about to be a reality. During the Arkansas Livestock Show to be held October 4–9 in Little Rock approximately three thousand children of the first six grades will have free bitewing radiographs taken, developed and mailed to their parents. It then shall be the responsibility of the parent to deliver these films to their family dentist for diagnosis.

This is a joint project of the Arkansas Unit, the Arkansas Board of Health and the General District Dental Society. Dr. J. R. Luten, Jr. of Little Rock is general arrangements chairman and his co-workers are Drs. R. L. Smith and Shirley Dwyer representing the G.D.D.S. and A.B. of H. respectfully.

Committee chairmen are Dr. Bryant Pake, Finance; Dr. Dick Harding, Personnel; Dr. Charles Fowler, Properties; Dr. Wheaton Cook, Developing and Mailing.

The Little Rock Dental Assistants Society and Central District Dental Auxiliary are helping with the paper work at the booth.

Missouri

The following slate of officers for the Missouri Unit has reached your editor "Via the grapevine"

John Holland.....	President
John Gilster.....	Vice President
Vernon Truetzel....	Sec'y-Treasurer
William Brandhorst	Corresp.-Sec'y

Tennessee

After tapping the same grapevine the only information that could be obtained about the Tennessee Unit is that Dr. L. W. Parker is the secretary-treasurer. Other officers are unknown to your "Unit News" editor, sorry.

Michigan

The active season for the Michiganders got underway on October 20 with a panel discussion on problems in orthodontics for the general practitioners. The members of the panel were

Allen Collins
Hilliard Hicks
Edward Martinek

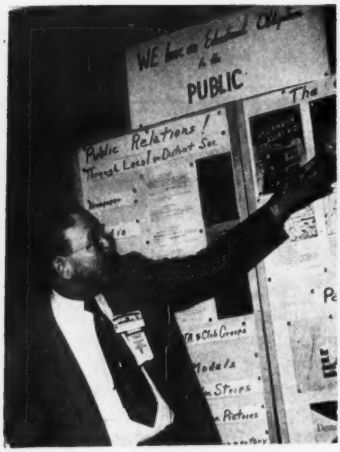
Dr. Hugh M. Kopel is the chairman of the program committee again this year and needless to say the Michigan Unit is looking forward to some mighty fine programs.

Oklahoma

From Oklahoma comes the good news of the formation of a new chapter of A.S.D.C. Organizational spade-work was done at the 1954 Oklahoma State Meeting, and the following officers were elected and authorized to request a Unit charter:

Dean Robertson, President—434 N.W. 13th Okla. City
C. A. Sebert, President Elect—Clinton, Okla.
Wm. N. Flesher, Vice President—Med. Arts Bldg., Okla. City
L. D. Wright, Editor—Osler Bldg.—Oklahoma City
J. Millard Robertson, Secretary Treasurer—City National Bldg., Okla. City

The accompanying pictures tell a story



A.S.D.C.'er V. C. Tisdal discussing the material in what was voted the best table clinic at the Oklahoma State Meeting, put on jointly with A.S.D.C.'ers C. A. Sebert and Lewis J. Bryant.

of real Unit activity! Keep up the good work, Oklahoma!

J. D. Moon and Joe S. Bryant

Southern California

Irving Rubel reports:

Things really started out with a bang for the So. Calif. Unit, and it appears that the local group is headed for another successful and instructive year.

Our president, "Slim" Havey, began

C. A. Sebert explaining Al Anderson's diagram on carbohydrate intake to E. B. Saul, while Lewis Bryant looks on.

the ceremonies with the presentation of a plaque to the past president, Harold Barnes, in appreciation for the superb job he did in the past year. Needless to say, the seminar at the Arrowhead Springs Hotel received national as well as local recognition.

The membership roster extends over the vast expanse known as Los Angeles with men appearing at meetings from San Diego to San Bernardino. Thus, it can be noted that the clinicians are well chosen for their excellence in their respective fields.

Washington

Over 35 members attended the fall meeting of the Washington State Unit, held Oct. 23 and 24, at the Edmond Meany Hotel in Seattle. Outgoing officers are; President—Dr. John Deines. President-elect—Dr. George Wood. Secretary-treasurer—Dr. Charles F. Meyer. Clinician was Dr. Eugene P. West of the Orthodontic Department of the U. of California Dental School, who spoke on "Problems of the Mixed Dentition."

At the Saturday evening business-dinner-meeting (which followed a fine, well attended social hour) the following new officers were elected for the coming year; President—Dr. George E. Wood. President-elect—Dr. Walter H. Smith. Secretary-treasurer—Dr. Harold D. Rosenbaum.

The next meeting will be in March 1955 in Seattle in conjunction with the meeting at that time of the State Dental Association meeting. Also in the offing is a projected joint meeting with the Oregon and British Columbia people in January 1956.

Colorado

The new officers of the Colorado State Unit are as follows:

President—Dr. Chester Pilcher
Downing Dental Building
2121 South Downing Street
Denver, Colorado

Vice-Pres.—Dr. Henry C. Gage
677 South Gilpin Street
Denver 9, Colorado

Secy-Treas.—Dr. William E. St. John
3705 East Colfax Avenue
Denver, Colorado

The kickoff meeting presented Marsh Robinson, D.D.S., M.D., head of Oral Surgery at the College of Dentistry at the Univ. of So. Calif. There was a fine meeting dedicated to cleft lip and palate restoration, and the relative merits of general anesthesia in the dental office. Many of the leading oral surgeons in the area were present which added to the interest of the evening with the question and answer session.

At our next get together, the group will hear Clarence H. Blanchard, D.D.S. whose subject will be Nutrition. This clinician has varied interests in the field of dentistry having lectured before national, regional, state, and local societies both in the United States and Canada. We are all looking forward to this next session with a great deal of anticipation.

Nebraska

Joe Britton reports:

At the April 1954 meeting in Omaha our Unit president, Sam Weinstein, introduced president-elect Herb Seeberg ot Hastings. Standing-room only prevailed in the Hotel Fontenelle's Black Mirror Room when Herb introduced our guest lecturer, Ken Easlick, whose presentation was unqualifiedly one of the very finest we have seen in this area, and we hope that he will honor us with another visit soon.

Our Unit met again in May to present

awards to seniors in our two dental schools who displayed interest and achievement in the field of pedodontics. Winners were William Carrales and John McRenalds of Nebraska University, and Ralph Herman and Ray Delio of Creighton. Ralph Ireland spoke to the assembly on the subject of "Graduate Training in Pedodontics".

Reflecting on the record of the past year we feel justified in our optimism concerning the condition of our Unit. It has been especially gratifying to see the spirit of enthusiasm throughout our ranks as shown by the attendance at our meetings. We can be proud of the record of our leaders and feel confident that they will build and strengthen our Unit in the future.

THE AMERICAN SOCIETY OF DENTISTRY FOR CHILDREN

APPLICATION FOR MEMBERSHIP

I am interested in becoming a member of the American Society of Dentistry for Children.

NAME..... DEGREE.....

ADDRESS.....

.....

If you are a dentist or physician, you must be a member in good standing of your local dental or medical Society.

If you wish associate membership, please indicate affiliate society membership.

Send this application to:

American Society of Dentistry for Children
Mt. Royal and Guilford Avenues
Baltimore 2, Maryland

Pulpotomy—A Symposium*

JOSEPH J. OBST, D.D.S., M.A., F.A.C.D.†

PULP therapy has as its aim the maintenance and preservation of vital and healthy pulp tissue. Pulp therapy includes indirectly operative dentistry and preventive techniques for the control of dental caries, and directly pulp capping, pulp curettage, and pulpotomy.

Pulp canal therapy begins when the entire pulp has been permanently injured or lost. We shall consider one direct phase of pulp therapy, *pulpotomy*. First, let us differentiate between pulp capping, pulp curettage, and pulpotomy.

Pulp capping, the simplest form of pulp therapy, has been practiced for over one hundred years. It is a procedure for protecting a slightly exposed pulp by means of an antiseptic or sedative substance, so that the pulp may regain normal function.

Pulp curettage is similar to pulpotomy, but only a small amount of pulp tissue is removed at the point of the exposure. Chatterton (1) suggests on the basis of eighty-six cases that there are no failures in this technique. The tooth is spared trauma and the natural pulpal defense mechanism remains intact.

Pulpotomy, or vital pulp amputation, refers to the cutting and removal of the coronal part of a vital, uninfected pulp, to retain life and function in the remaining pulp stump.

It is recognized that the best type of pulp canal filling is a vital pulp.

In regard to pulp capping, Coolidge, Grossman (2), and Hogeboom agree that it should be used on teeth where the pulp has been accidently exposed. Rosenstein (3), however, has had 90% success in pulp capping procedures on vital primary and early permanent teeth with carious exposures.

INDICATIONS

To repeat, a vital pulp is the best pulp canal filling. Pulpotomy may be indicated in uninfected pulps of children and young adults' teeth where pulp canal therapy might be impractical or not indicated. It may be indicated in the primary teeth, or in children's teeth with wide-open foramina where pulp capping might be contra-indicated—for if it failed, pulp canal therapy becomes difficult. Another indication is in cases of injury to childrens' teeth in order to allow the roots to complete their formation. When the roots are completely formed, pulp canal therapy procedures may be employed (4, 5, 6).

CONTRA-INDICATIONS

Pulpotomy is contra-indicated where an infection of the body of the pulp exists, where the rubber dam cannot be applied, and where the root is fractured or displaced.

The difficulty of determining just when pulpotomy or pulp canal therapy should be instituted is primarily one of diagnosis of the condition of the pulp. Exact diagnostic tests to ascertain pulpal pathology are not available at the present time.

Success in pulpotomy primarily de-

* Presented before the Section on Dentistry For Children, Second District Dental Society of the State of New York.

† Director and Chief, Williamsburg Settlement Childrens' Dental Clinic, Brooklyn 6, N. Y.; Director of Dentistry, Jewish Chronic Disease Hospital, Brooklyn 3, N. Y.

pends on a correct diagnosis, the use of accepted methods, the maintenance of asepsis and normal tissue function and the resistance and health of the individual. One does not treat a tooth, one treats a total individual.

Diagnostic Methods

Diagnostic methods available at the present time include x-ray examination, clinical examination, vitality tests, a knowledge of the history of the tooth and the physical condition of the patient.

It has been demonstrated that a pulp exposed either by accident or by caries, and operated upon observing the precautions enumerated, will retain its vital functions and continue to produce dentin at the point of operation. This process has been compared to the healing of wounds on body surfaces. An injured or damaged pulp is not necessarily a lost organ. There is adequate clinical and experimental evidence to prove that pulpotomy and pulp capping where indicated are not experimental but are safe, practical clinical procedures.

However, results are not always successful simply because the clinical picture of the pulp being treated may mask a variety of pathological conditions. Thus as in other branches of medicine, the progress of a tooth being pulpotomized cannot be accurately ascertained unless the diagnosis is accurate. Diagnosis governs prognosis and our failures are generally due to an inaccurate or incomplete diagnosis, where the technique employed follows generally accepted procedures.

Clinical Methods

Let us evaluate two of the diagnostic methods available to us. The first is x-ray examination. The radiograph, so useful in other phases of dentistry, is of no value when we seek to determine the histologic, bacteriologic and pathologic picture of the involved pulp (7). Secondly, we may consider clinical examination. Clinical methods have always been unsatisfactory. Reactions to temperature changes, to percussion, and to the electric current give no positive proof of the bacteriologic or histopathologic picture of the pulp.

The clinical sign of hemorrhage is of limited value since a gangrenous pulp may still bleed.

Laboratory Diagnosis

Reliable differential diagnosis of pulp diseases is possible only after extractions by means of laboratory examination. This, however, is of no value to the clinician who is trying to save the tooth.

It is obvious that thorough research is essential for the determination of a differential diagnosis of pulp diseases, and if a method could be found, the clinician would easily be in a position to apply the suitable technique of pulp therapy or pulp canal therapy.

Such a method of pulpal differential diagnosis may be closer at hand than many of us suspect. Prader, through Draker, in 1949 suggested such a means (8). For the past two and a half years we have been trying to confirm the value of a local differential blood count coupled with a bacteriologic test. It is too early as yet, to confirm the observations of Prader.

For many decades it has been known that inflammation results in a change in the local blood picture, and the change suggests its cause. Damage to capillary walls results in emigration, accumulation of the formed blood elements, mainly polymorphonuclear neutrophils accompanied by eosinophils and later on by monocytes and lymphocytes. Schilling

reported on the meaning of the white blood cell in infection—granulocytes are increased in number in acute infections, monocytes in sub-acute and lymphocytes in chronic conditions. Diagnostic conclusions can be drawn by comparing normal values with the pathologic values found in disease. Prader applied this fundamental concept to the differential diagnosis of pulp diseases. He observed that the local blood picture of an inflamed pulp quickly reflects pathologic changes.

A smear is obtained from the pulpal exposure and a local differential blood count is made.

The following is an example of the significance of a local differential count: A slowly increasing lymphocytosis (normal, 20% to 22%), (from 26% to 38%) with no or slight change in neutrophils, no increase in stabs and a monocytosis of 1% (normal 3% to 6%) would be an early reaction to toxins and/or irritation and would be a good prognosis for successful pulpotomy (8).

As the inflammatory process continues: monocytes are 18% or lower, lymphocytes marked by increase up to 57%, total neutrophils tend to be lower. Since this is considered a reversible pulpitis, here too, pulpotomy might be indicated (8).

Then as increased infection occurs with gram positive organisms visible in the smear, fundamental changes result in the local blood picture. Segmented neutrophil polys increase to 70%–80% or 90%–100% (normal 58%–66%). Instead of a lymphocytosis, a lymphocytopenia results with values down to 15%–19% and later on to 1%–2%. Monocytes disappear even faster. The total number of white blood corpuscles increase to 50,000 and in fact may equal the number of red blood cells (4–6 million, normal). No pulpotomy is indicated at this stage and if attempted, it would be unsuccessful. Only pulp canal therapy becomes the method of choice (8).

It would appear that with the application of the local differential count and the bacteriologic test, the clinician might be in a position to abandon to a great extent, the empirical methods used at present. This would be a great advance not only in obtaining more consistent results, but also would raise the standards of the profession in that we should be using biologic methods in operating on vital oral tissues, thereby increasing the respect of the other scientific professions toward ours. Pulpal diagnosis would be placed on a more reliable basis.

Pulpotomy Technique

The following is a chairside, step-by-step procedure for pulpotomy: 1. x-ray and record stimulus threshold, 2. obtain anesthesia, 3. apply rubber dam, 4. sterilize field of operation, 5. remove all caries using sterile instruments and dry with sterile cotton, 6. open into pulp chamber using sterile burs—obtain access in straight lines removing roof of pulp chamber, 7. with sterile excavator or #6 round bur, remove coronal portion of pulp down to floor of pulp chamber, 8. for bleeding, hold sterile piece of cotton gently, but don't let pulp dry out, irrigate with a warm aqueous solution of calcium hydroxide, 9. apply calcium hydroxide and sterile water mixed, on pulpal floor without pressure, 10. place paraffin coating over this, mix or flow a thin mix of oxyphosphate of zinc cement over it, 11. take postoperative x-ray. Test pulp at intervals—stimulus threshold will be found to be slightly higher than previously.

Clinically, zinc oxide-eugenol mix seems a satisfactory pulpotomy substance but histopathologic examination shows calcium hydroxide forming a dentin bridge

without inflammatory cells within the remaining pulp tissue, whereas in zinc oxide-eugenol, a persistence of chronic granulation tissue and inflammation takes place (9). Thus with calcium hydroxide, healing occurs usually ten weeks after exposure and the odontoblastic layer is restored. The exposure is walled off by a bridge of dentin—the pulp tissue is normal and free from inflammation (10, 11, 12, 13).

Finally, even with the use of the biologic pulpal diagnostic methods suggested, our pulpotomy technique must be carefully performed.

Extreme caution must be employed in maintaining asepsis and care must be taken in grinding the tooth because the local anesthetic (with epinephrine) temporarily hinders the normal metabolism of the pulp (no patient response either)—thus pulpotomy may be a failure from the start (14).

Summary

To summarize, success in pulpotomy depends primarily on a correct diagnosis. Once the histopathologic and bacteriologic picture can be accurately determined, the following principles will insure a successful operation:—first, the maintenance of an aseptic technique and second, the use of a generally accepted method.

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Pulpotomy—A Critical Evaluation

SAMUEL LUKS, D.D.S.*

MANY extravagant reports have been made from time to time with reference to the number of excellent results achieved in pulp capping and pulpotomy procedures. Great faith is ascribed to various preparations used for these operations but roentgenographic evidence to support these claims is conspicuous by its absence. Men who report success in hundreds of cases have yet to produce the roentgenographic evidence, in quantity, to support their claims.

Our own observations and experience over a period of years covers permanent anterior teeth and molars where the root ends were incompletely formed and complete endodontia was contra-indicated. The number of cases we treated was substantial. These cases were followed closely at six month intervals and radiographic check-ups were taken for as long a period as we could get the patient to come back. In spite of our very best efforts the majority failed to come back. Finally we were left with a small but representative group of cases on which our check-ups ran anywhere from two to five years.

In this group we noted as many successes as failures. Later, when we re-evaluated the successful cases we were able to find after the initial repair where the root ends were completely formed evidence of continued calcification proceeding from the remnant pulp stump progressively toward the root end.

Case 1: In figure 1 are shown roentgenograms of an upper left central incisor of a young patient where the pulp was exposed as a result of an injury. A paste of zinc oxide and eugenol was used. In this case the root has gone on to completion. If the root canal is now compared with the adjacent tooth it will be noted that there is marked constriction with evidence of continued calcification. Were it possible to follow this case further it should eventually end in complete obliteration of the root with ultimate strangulation of the pulp remnant at the very apex.

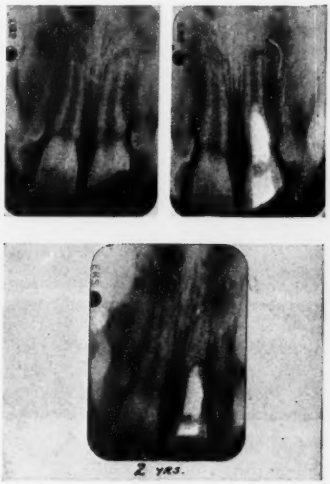

FIG. 1

Case 2: Figure 2 illustrates pulpotomy performed on a young patient on a first permanent molar where the root ends are completely formed. Approximately a year later fairly well defined area is evident around the distal root of this tooth. Although complete endodontia is still

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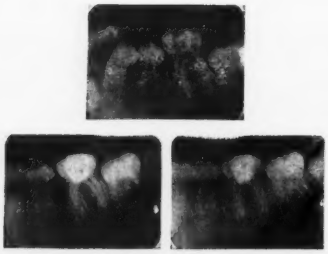

FIG. 2

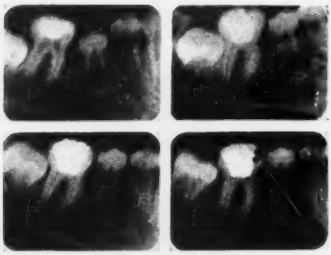

FIG. 3

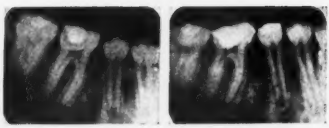

FIG. 4

possible it should have been the original treatment of choice since the root ends were already completed at the time the patient presented for treatment.

Case 3: Figure 3 is that of a young patient with a vital carious exposure. Here the root ends are open and incomplete. Pulpotomy was performed using zinc oxide and eugenol. After approximately two years the root ends are closed off and the adjacent dentition has benefitted, by the retention of the first permanent molar, to go on to normal growth and development.

Case 4: Figure 4 illustrates a young patient with a first permanent molar where the carious exposure involved the pulp horn. Against our advice a pulp capping procedure was performed. Two months later well defined apical areas are visible. Complete endodontia can still be performed although under less favorable circumstances.

Case 5: Figure 5 illustrates the end result of a pulpotomy performed eight years previously. Note evidence of long standing chronic apical infection. Note the extent of root resorption taking place. Complete pulpectomy at this stage is no longer feasible.

Case 6: Figure 6 shows the end result of a pulpotomy performed on a six year molar. In this case complete endodontia was performed. Approximately a year and two years later complete healing has taken place, illustrating graphically that complete removal of all tissue whether vital or necrotic is the treatment of choice wherever possible.

FIG. 5

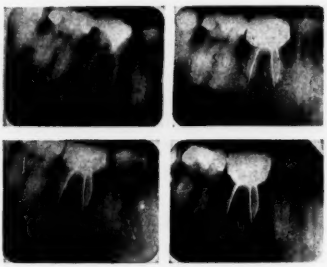

FIG. 6

Conclusions

There is no doubt that partial pulp treatment is a valuable service for young patients where the teeth are vital and the apices incomplete. However, partial treatment should be considered an emergency interim service to be followed by complete pulpectomy after the root ends are completed. Partial pulp treatment for adults is a highly risky procedure and contraindicated.

Pulpotomy in Primary and Young Permanent Teeth

DANIEL F. TOBIN, D.D.S., F.A.C.D.*

THERE is no evidence in the literature which validly opposes pulpotomy as an acceptable procedure where it is indicated. Since there is no question about this operation as a standard treatment, I have chosen to discuss its indications and uses. The least that can be said of it, is that it serves as a reprieve for a tooth otherwise destined for removal. The most that can be said of it, is that it is a convenient procedure for an affected tooth which we wish to retain in function for a more or less specified period of time.

As to the useful life span of a pulpotomized tooth, there seem to be no studies suggesting that we might expect better than five years as the average service life of a pulpotomized tooth. Of course many of us have seen first permanent molars still in function after ten years following pulpotomy, but it is not likely that a large percentage of cases render such long-term service. Accordingly, pulpotomy cannot be regarded as a substitute for complete pulp canal therapy, but rather must be viewed as a convenient operation to carry a tooth over a strategically important period of time.

The basis for this point of view may be found in observations of the changes that the radicular pulp stumps undergo postoperatively. It is common knowledge that this residual vital tissue behaves in at least one or more of four different ways:

1. It may continue its function of normal dentinogenesis at a rate equal to that of its mate in the other side of the same arch. This refers of course to permanent teeth. The comparable behavior in the primary teeth would be a normal rate of root resorption.

2. It may accelerate the rate of dentinogenesis to the point of obliterating the canals in either permanent or primary teeth.

3. It may manifest retrogressive changes in the form of internal resorption. This is more commonly observed in the primary dentition.

4. It may degenerate to a state of moist or dry gangrene, with or without evident radiographic radiolucency in the periapical areas in the permanent teeth, and in the bifurcation or trifurcation areas of the primary teeth.

A suitable area of research would be the determination of the incidence of these changes and the postulation of why they take place. Two obstacles to such a study would be first, the lack of availability of the patients over a long enough period; and second, the difficulty of determining the state of health of the radicular pulp where there is absence of symptoms or lack of radiographic evidence of pulp pathology.

The occasional pulpotomy case wherein the crown has severely fractured after 2 or 3 years sets up this speculation, when it is noticed that a necrotic radicular pulp is often present without symptoms or detectable radiographic evidence. As to the seemingly productive changes which are seen in instances of pulp obliteration

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by excessive dentinogenesis, it is not rare to see a periapical radiolucent area develop eventually. This appears to explode the concept of a "natural root canal filling".

Nevertheless, in spite of these discouraging findings at times, there is ample clinical evidence of a high degree of success in pulpotomies. The most effective use, of course, is in the primary and young permanent teeth. The useful life of a primary tooth in the erupted state varies from five to six years for incisors, to almost ten years for some molars, excluding those that may have no permanent successors. Patients in the age group of about 4 to 8 years are the likeliest candidates for pulpotomies of the primary teeth. Success in operating on second primary molars seems to exceed the percentage of success on first primary molars.

As it was established earlier that pulpotomy has some time limitation in its application, it would seem that it is better suited in that regard to the primary than to permanent teeth. Paradoxically enough, in more than twenty years of doing pulpotomies at the Guggenheim Clinic with a total number of pulpotomies exceeding 15,000, the success of the cases as measured clinically, both by physical diagnosis and radiographs, indicated that the permanent teeth consistently evidence a higher percentage of success than do the primary. There is one mitigating circumstance of importance, namely, that the criteria of success have rarely exceeded a time limit of more than six years following the operation. I should guess that these so-called "successes" after 6 years may turn out to be failures, but certainly could continue as successes if complete pulp canal therapy were done about the time that the root apices were completely formed, and before excessive dentinogenic activity all but obliterated the root canals.

After all these generalizations I should like to get down to precisely where pulpotomy is indicated and why it serves a useful purpose:

1. As a time-limited measure in any tooth worth saving at all, if the exposure is small, clean and the paradontium is in a good state of health and the patient is free of any systemic disease.

2. In any primary tooth if there is at least one year's expectancy before its normal exfoliation and the accession of the permanent successor. Primary incisors may be excepted and not included, as their loss is rarely of importance in arch integrity in terms of growth and development.

3. In the first permanent molars because they are not only important to the growth and development of the arches, but because their incidence of caries almost equals the total of all the other permanent teeth, the lower first permanent molars even markedly more so than the uppers.

4. In second permanent molars because they lend valuable joint growth and development assistance to the first molars, and similarly have a high rate of caries incidence.

5. Incisors, uppers more so than lowers, largely because of their vulnerability to fractures, nearly or frankly exposing the pulp horns before the root apices have fully formed.

6. Premolars are border line choices because the inroads of caries do not threaten the pulp until close to complete root formation. An added consideration is the fact that the least amount of success with pulpotomies is experienced in premolars. Complete pulp canal therapy would be the operation of choice, with perhaps a few instances wherein the pulpotomy may be used as a short tem-

porary measure to cover the period until pulpectomy may be more expeditiously performed.

In all cases involving the permanent teeth, it would serve the best interests of the patient, if at the time pulpotomy is decided upon, that complete pulp extirpation be a subsequent possibility, if the patient cares enough to desire to retain the tooth as long as possible. If this fact or attitude is in doubt, there are many times when the extraction of the tooth at the occasion of the original exposure may do less damage than the retention of the tooth and subsequent loss at a time when arch integrity would be more seriously threatened.

In this connection let us consider the permanent tooth most often pulpotomized, the lower first permanent molar. At age eight or nine the presence of an exposed pulp in a first permanent molar would suggest pulpotomy if all other factors are favorable. Let us suppose the case is "successful" for 6 years but shortly thereafter a radiolucent area is detected and the canals are virtually impenetrable. You will agree that extraction of the tooth would be a strongly possible recommendation. Match what will happen to those arches at 14 or 15 years of age with the removal of that molar, as compared with what would happen had the tooth been removed originally. It has been a policy of the Guggenheim Clinic for many years that at ten years of age or earlier, extensive involvement of 3 out of 4 six year molars with two or three of them pulp involved but amenable to pulpotomy, to extract all four molars. If any serious consequence has occurred as a result of this policy, I have not witnessed it.

Conclusions:

1. Pulpotomy is a useful and important operation if employed judiciously.
2. Pulpotomy is not a substitute for complete pulp canal therapy.
3. Pulpotomy may be used as a preliminary treatment to subsequent complete pulp canal therapy.

Around the Country

It's encouraging to see more and more articles on dentistry for children appearing in the dental journals. The *Chronicle* of the Omaha District Dental Society is running some as a regular feature, by *D. D. Gustafson*, Omaha, Nebraska.

* * *

On September 14, the Chicago Dental Society, through its committee on Dental Health Education, began a 13 week series of dental health education TV broadcasts over station WBKB from 1:15 to 1:30 p.m. on Tuesdays and Thursdays. The first broadcast on Tuesday, September 14 was "Pedodontics" and Dr. *Stanley Korf* appeared on the program.

* * *

An Indiana unit of the A.S.D.C. was organized in May. Its president is Dr. *Ralph McDonald*, Indianapolis. Its second meeting was held on October 8 in Bloomington in conjunction with the Indiana University Dental Alumni meeting.

* * *

Charles Sweet, Sr., Oakland, California was guest speaker at the annual meeting of the Colorado State Dental Association at Colorado Springs on October 4. His subject: "A Capsule Course in Dentistry for Children." Table clinics at this meeting were given by *J. M. Eisenson*, Denver, "Space Maintenance" and by *John W. McCullough*, "Vital Pulpotomy."

* * *

Oren A. Oliver, Nashville, Tennessee, was elected to a third term as president of the Federation Dentaire International at its 42nd annual meeting June 8–13th in Scheveninger, Holland.

Walter C. McBride, Detroit, has been named to replace the late *Dr. Paul Bomberger* on the Council of Journalism of the A.D.A.

* * *

A very interesting biographical sketch of *J. Robert Short*, Kalamazoo, appeared in the July–August issue of the Journal of the Michigan State Dental Association. *Dr. Short* has been very active both in his profession and in his community. For a man so young he has made a remarkable record, one of which he can be justly proud.

* * *

Sixty-five dentists have joined together to form a North Carolina Unit of the A.S.D.C. Elected president at their first meeting May 18, was *J. B. Freedland*, Charlotte.

* * *

The College of Dentistry, Ohio State University has arranged a post graduate course in Pedodontics given by *Dr. Lyle S. Pettit* and *Dr. Ben H. Williams* May 16–20, 1955. Further information is available from College of Dentistry, O.S.U., Columbus 10, Ohio.

* * *

A three day course in Dentistry for Handicapped Children will be given on 7th, 8th, and 9th March 1955 at the School of Dentistry, University of Pennsylvania. The course will include an orientation relative to the various handicapped conditions, their oral manifestations including speech defects, roentgenologic technics, medication and sedation prior to office, home or hospital

treatment and the psychosomatic approach to these patients.

This course is under the supervision of Dr. M. Album assisted by Drs. F. P. Bakes, Burton Chance, Jr., M. Cohen, W. M. Krogman and C. F. McKhann. The tuition fee is $75.00. The enrollment is limited.

For further information write—Director, Postgraduate Courses, School of Dentistry, University of Pennsylvania, 4001 Spruce Street, Philadelphia 4, Pennsylvania.

* * *

Dr. Frank J. Orland has been appointed director of the Walter J. Zoller Memorial Dental Clinic at the University of Chicago. Dr. Orland, who has been associated with the clinic since 1941 and with the university since 1935, succeeds Dr. J. Roy Blayney, who has retired after heading the clinic since its founding in 1936. Dr. Blayney is continuing as director of the Evanston fluoridation study which he initiated eight years ago.

* * *

Walter McFall, Asheville, North Carolina, spoke before the New York Academy of Dentistry on February 4 during National Children's Dental Health Week. His excellent address is printed in full in the September *Annals of Dentistry*.

* * *

In May, *Don Brody*, assistant professor of pharmacology at the University of California, spoke before the San Mateo County District Dental Society on the use of newer medicines in dentistry for children with special emphasis on control of pain and infection.

* * *

The State University of Iowa offers its next postgraduate course in Dentistry for Children, January 17–22, 1955. The course is designed to assist the general practitioner in treating children. Emphasis will be placed upon the management of the child and the various technical procedures in pedodontics. Practice in the Children's Clinic of the College of Dentistry will allow the participant to experiment with concepts and technics presented.

For detailed information write to *Dr. Kenneth E. Wessels*, Professor of Pedodontics, College of Dentistry, University of Iowa, Iowa City.

* * *

The Children's Hospital of Philadelphia is accepting applications for a one-year, full-time, A.D.A.-approved dental residency which begins July 1, 1955. The yearly stipend is $1,200, with maintenance.

The residency provides training in all phases of pedodontics, oral surgery, oral medicine and operating-room techniques.

For further information, write to *Raymond Werther, D.D.S.*, Chief of Dental Service, The Children's Hospital of Philadelphia, Philadelphia 46, Pa.

* * *

The following course will be offered at Tufts College Dental School during the 1954–55 academic year. DPG. 501—Oral Pediatrics; Monday, Tuesday, Wednesday, July 18, 19, 20, 1955. Tuition $150.00. Class limited to 10. *Dr. Frederic Shiere* and Staff.

Further information can be obtained by writing the Director of Graduate and Postgraduate Courses, Tufts College Dental School, 136 Harrison Avenue, Boston, Mass.

* * *

Sidney Kohn and *John Fenton*, Jersey City, presented a table clinic "Pedodontic Problems" at the October meeting of the New Jersey State Dental Society.

* * *

The Southern California unit of the A.S.D.C. met on September 27. The

speaker was *Marshall Robinson*, M.D., D.D.S. and his subject was "Oral Surgery for Our Children."

* * *

Last spring, the Orthodontic Society of Portland, Oregon, presented an interesting clinic. Each participating member presented a short lecture or demonstration on different aspects of orthodontics which could be of value to the dentist interested in a child's oral health. This type of program was so popular the Portland Unit of the A.S.D.C. will use it again this year.

* * *

Bill Brown, Ann Arbor, presented a paper the "Treatment of Traumatized Young Teeth" at the annual meeting of the Tennessee Society of Dentistry for Children, May 9. His excellent paper was printed in the July issue of the *Journal of the Tennessee State Dental Assocation.*

* * *

"Working With Children," by *William H. Danley, Jr.* of Albuquerque, New Mexico, which appeared in the summer issue of the New Mexico State Dental Journal, is an excellent article on many aspects of dentistry for children.

* * *

The Arkansas Unit of the American Society of Dentistry for Children sparkplugged "Operation Bitewing," a program to take free dental x-rays of school children during the Arkansas Live Stock Show, Oct. 4–9.

* * *

William Cody spoke before the Ohio State Dental Association October 18. His subject was "Adult Dentistry for the Child Patient."

William Brandhorst, St. Louis, presented "Orthodontics of Use to the General Practitioner" at the same meeting.

Quentin Ringenberg, St. Louis, has returned from active duty with the Air Force and has reopened his office for the practice of orthodontics, 3720 Washington Ave., St. Louis 3, Mo.

* * *

Earl E. Shepard, St. Louis, just retired as president of the Central Section of the American Association of Orthodontists.

* * *

The three Teutsch brothers, Stanley, Chuckie and Tommy are happy to announce a new member of their family, Richard Lee, born October 30, 1954. Daddy Laren is on active duty with the Navy at Santa Ana, California.

* * *

The Harold D. Rosenbaums, Seattle, Washington have a daughter, Betsy Davida, born August 11, 1954.

By action of the Executive Council of the A.S.D.C. upon recommendation of the Editorial Board, "*Around the Country*" bids farewell to its friends with this issue of the *Journal*. Born in 1944, when *Editor Al* took over, this column has brought you the personal items about our members, in a friendly, familiar style which we hope you will miss. To its retiring *Editor, Jack Gilster*, goes our thanks for a job well done, along with the promise of a new assignment in the future. Drop us a line with your comments or suggestions.

A. E. S.

A Simple Home-Supply of Fluoridated Water for Children

VICTOR H. DIETZ, D.D.S., PH.D.
St. Louis, Missouri

If you can measure that of which you speak, and can express it by a number, you know something of your subject; but if you cannot measure it, your knowledge is meager and unsatisfactory.
Lord Kelvin

SINCE the introduction of various schedules for the precise intake of sodium fluoride tablets in the control of dental caries (1), additional important data have been assembled and analyzed. These data are now complete for the year from June 30, 1953 to July 1, 1954.

Recently, a third method by which the fluoride ion may be safely introduced into the human body was developed. This method simply consists of adding sodium fluoride tablets to the five gallon water bottle of a conventional water cooler. These bottle-reservoir water coolers are commercially available on a rental basis. The St. Louis municipal water supply contains an ambient fluoride concentration of 0.33 ppm. Consequently, 18 sodium fluoride tablets (each yielding 1 mg. of the fluoride ion) are usually placed in five gallons of this water. This constitutes a supplementary fluoride concentration of approximately 0.9 ppm. The resultant fluoride concentration is about 1.23 ppm. This may be varied seasonally as desired or as dictated by individual differences in water intake.

Fig. 1 demonstrates the simplicity of using the water cooler by children. A clean cup is always available and the easily manipulated push-button tap is sufficiently low that even two year old children can provide water for themselves. This method provides an excellent experimental set-up for the study of the water intake among the single child families. The evaporation factor is negligible as the water system is closed. Of interest is the fact that children invariably drink every drop from the small paper cups. Reports to date indicate that the care-free simplicity of using this method is preferred, especially, by large families.

Among 40 children varying from 1–8 years of age, the volumes of water consumed were found extremely erratic. It appears, therefore, that the occasional quibbling over the fact that fluoridated water, during certain seasons, should contain, optimally, 0.75 ppm, 1.2 ppm or even 1.5 ppm is just another example of "the battle of the decimal point" carried to unnecessary extremes when a greater variable is ignored. Ultimately, of course, we must arrive at a practical concentration not only for the variation in the seasonal intake but to take into consideration individual differences in the volume of water consumed if possible. Primarily, the question remains: "During which seasons and to what extent must the fluoride concentration be varied in order to be optimally effective?"

As an example, taking the five children

in our approximate two to three year old group, Table 1 shows the variation in water intake the year around.

An analysis of the preceding data reveals:

1) The average daily consumption of water for 2–3 year old children is approximately 0.88 liter the year around.

2) The winter, spring and autumn intake are about the same and averages not quite ¾ of a liter.

3) The summer intake is comparatively high (1.31 liter).

4) Individual differences are so great that one child was found to drink practically only half that of the average volume intake of the other four children.

5) The child consuming the greatest amount of water demonstrated a natural intake of practically one and a half times the average amount.

6) The child drinking the most water consumed over twice the amount of the child having the least intake.

TABLE 1

Water consumption of five 2–3 year old children arranged according to increasing intake from 1 to 5. The approximate average daily intake is given in liters for the various seasons

Child	Extreme Seasons		Mild Seasons		Daily Av. for Year
	Winter (Dec., Jan., Feb.)	Summer (June, July, Aug.)	Spring (Mar., Apr., May)	Autumn (Sept., Oct., Nov.)	
1. (SS)...	0.45	0.8	0.4	0.35	0.5
2. (GW)...	0.75	1.1	0.55	0.70	0.78
3. (FW)...	0.6	1.5	0.8	0.95	0.96
4. (KC)...	0.9	1.4	0.75	0.85	0.98
5. (RB)...	0.85	1.75	1.1	1.0	1.18
Averages	0.71	1.31	0.72	0.77	0.88

FIG. 1. The kitchen is the most convenient place for the water cooler. Children obtain fluoridated water while parents may drink from the municipal supply.

DISCUSSION

It is apparent that children in the various age groups will demonstrate great differences in the volume of water consumed. Children under two years of age show even greater variation. This fact may mean, for example, that two-fifths of the children are actually sparsely protected. The latter may be partly the reason for only a 60% reduction in dental caries most frequently reported. Two-fifths of any arbitrary age group may be optimally protected (i.e. caries-free without mottling). The remaining fifth may be "maximally" protected (i.e. caries-free with a mild degree of mottling). The latter may account for the 10–20% of mild mottling that is consistently reported among children drinking water containing the accepted optimum of 1–1.5 ppm fluoride ion.

Obviously, the variation in water intake is even more difficult to evaluate for

children after three years of age. Nursery schools and other activities all too frequently take them from the home and make a critical evaluation impossible. It is on the basis of the original 40 children observed that the precise intake of the fluoride ion seems increasingly important. The taking of a tablet yielding one milligram of the fluoride ion (equivalent to 1 ppm fluoride ion on the basis of one liter of water consumed daily) insures the precise dosage. The ambient fluoride concentration of the St. Louis municipal water supply, as stated, is about 0.33 ppm. If the water volume variable is held at such a low fluoride concentration, the results should be rather consistent.

Our data are scanty for total fluid intake. However, milk, fruit juices, and soft drinks are undoubtedly greatly responsible for the variable water intakes reported. One child, a rather obese girl, 6½ years of age, prefers water to any other fluids. As a result, she drinks almost three times as much water as the average consumption in this age group. This poses the interesting hypothesis that her total water intake, $3 \times 0.33 = 0.99$ mg. fluoride ion, may naturally approach the ideal concentration. As a result of this finding, this girl has been restricted to three sodium fluoride tablets weekly. Children apparently drink cold water with greater relish than water at the usual tap water temperature and consequently in slightly greater volume. This is especially true of our 1–2 year old group. The cold water seems to relieve the "teething distress". The natural interest of children in the water dispensing mechanism cannot be entirely discounted as a psychologic factor in at least slightly increasing the water intake.

Children away to school for about 6 hours during the day may have the water adjusted to an average 1.5 ppm if this intake is average and the fluoridated water dispensing mechanism is not available at school. The method of choice for introducing the fluoride ion into the

TABLE 2

A comparative decigrade chart showing advantages and disadvantages of the various methods. These attributes are weighted from A—most favorable to C—least favorable. Each column contains an arbitrarily and mutually exclusive "ABC" classification

	Municipal Fluoridation	Home-supply of Fluoridated Water	Administration of NaF in Tablet Form
Ease of administration	A	C	B
Precision in dosage	C	B	A
Applicability to rural children	C	B	A
Applicability to urban children	A	C	B
Reported effectiveness	C (50–70%)	B (60–70%)*	A (75%)
Effect on primary teeth	C	B	A
Effect on permanent teeth	C	B	A
Avoidance of fluoridated water for adults or other uses	C	B	A
Exclusive control by dental, medical and pharmaceutical professions	C	B	A
Cost	A	C	B
Total	3 A's 7 C's	7 B's 3 C's	7 A's 3 B's

* Theoretical.

human body, under any given set of circumstances, is ordinarily dictated by expediency (Table 2). One sodium fluoride tablet to a liter of chilled water is just as palatable as nonfluoridated water. Two tablets to a liter of water becomes unpalatable because of the saline vehicle. This acts as a protective measure in eliminating the possibility of overfluoridating the home water supply.

However, fluoridation of the communal water supply has the advantage of benefitting most urban children to a considerable degree. For three years the various health agencies of St. Louis failed to effect the fluoridation of the municipal water supply, yet the dentists of St. Louis and its extensive environs countered this adamant stand by other means. Thousands of children are rigidly following the tablet-a-day schedule, and others the recently introduced simplified home method for administering fluoridated water to children only. The latter procedure also appears quite favorable, and like the tablet form, at least overcomes the objections of the opponents to fluoridation.

Summary

1) A simple method for supplying children with a home source of fluoridated water is described. This procedure is recommended where the fluoride content of the water is low or virtually nonexistent.

2) The data revealing the variation of water intake among a group of five children within the 2–3 year old age group are presented.

3) Three methods for making the fluoride ion available to children now exist. The most precise control over the intake of the fluoride ion appears to be the taking of tablets. The home supply of fluoridated water can be adjusted, if necessary, to the needs for a single child but may not be appreciably altered in a family of two or more children under eight years of age. Municipal fluoridation offers broad coverage but cannot take into consideration the individual variation in water intake. The latter, unfortunately, offers no solution for rural children.

4) All three methods of supplying children with the fluoride ion under various physical, seasonal, and other environmental conditions must be assiduously evaluated through the years so that all children everywhere may be optimally protected against dental caries.

5) The variation in water intake is difficult to evaluate on children after three years of age. Nursery schools and other activities all too frequently take them from the home and make a critical evaluation impossible. The variations found among only five children in the two to three year old age group suggest that large scale institutional observations, in the future, will probably show differences in water intake greater than those herein reported.

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